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VOL. XVI. DECEMBER, 1895. No. 192.

NOTE ON A PHOTOGRAPHIC METHOD OF DETERMINING THE COMPLETE MOTION OF A GUN DURING RECOIL.

BY
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IT is often desirable to have a permanent record of the paths described by the points of a moving body, which is changing its position so rapidly that the eye is unable to observe them; and where is it not practicable to interfere with the motion of the body by causing it to trace its own path mechanically upon some surface. This may be done by causing the light from the moving body itself to record its own path upon a photographic plate, The method has many advantages to recommend it; for example. the motion of the body itself is not interfered with, and the path may be easily reduced to any desired scale. It is usual in investigating the motion of rapidly vibrating phenomena, such as tuning forks, stretched strings, variable electric currents, etc., to employ a *moving* photographic plate; but to determine the path alone, a sensitive plate need have no motion, but may remain at rest and be used in the ordinary way.

The details of experiment vary according to circumstances. An example will illustrate a method of experimenting. Suppose that the moving body is a wheel rolling upon a level rail, a model in the laboratory, and it is desired to record the motion of one point in its circumference. Place an ordinary camera at any convenient distance from the wheel perpendicular to its plane, and focus sharply upon it. Attach to some point of the circumference of the wheel a luminous object such as a small incandescent lamp. This experiment requires that the room be dark, a condition easily obtained by working at night. First expose the camera, then roll the wheel carrying the small lamp across the field of view, then close the shutter. The exposure may be made in the dark-room for any length of time without fogging the plate. Upon developing it will be found that the image of the lamp has described a miniature cycloid upon the plate, an exact reproduction of the path described by the point of the wheel, and reduced in the ratio of the size of image to object.

Though the results obtained by experiments conducted upon the plan just indicated are perfectly satisfactory, giving good clear negatives with sharp curves distinctly traced upon them, as trials which we have made conclusively prove, yet in many cases the inconvenience of experimenting in a dark-room is a great advantage.

Another plan involving the same principles but enabling the experimenter to work in strong sunlight is the following: Prepare a dead black screen of considerable area, sufficient to more than cover the complete motion to be recorded; attach it to the moving object, and to the centre of the black screen fasten a bright bead. The brilliant element of the bead in strong sunlight, in contrast to the black screen which forms the background, will be sufficiently bright to describe a curve upon the plate. In this work sensitive plates are required and care must be taken that the exposure, before and after the motion has taken place, is as short as possible to avoid unnecessary fogging.

If instead of a single luminous point two or more such points are placed upon the moving object, the negative will show two or more curves, and from them the motion of the body may be

completely determined,—that is to say, its path through space may be so determined. There is, however, no accurate indication of the velocity which the moving body has at various points of its path. It should be said that the negatives do indicate roughly when the velocity is fast or slow, and when it is increasing or decreasing, by the intensities of the trace due to the relative times of exposure of each point. If by any means the source of light upon the moving object could be made uniformly intermittent, such as the sparks from an electrical tuning fork for instance, then the record would not only give the path of the body, but the velocity at each point of the path as well.

TO DETERMINE A RECOIL CURVE.

The above principles were applied to determine the behavior of a U. S. Army Springfield rifle during its recoil. The arrangement of apparatus is represented in Figure 1.

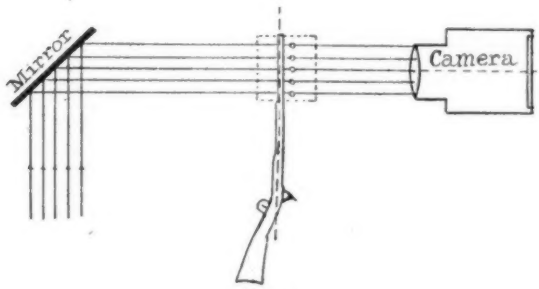

FIG. 1.

The rifle was fired from the shoulder as in ordinary practice It is represented in the figure revolved through a right angle into the plane of the page to show the position of the luminous holes. Upon the muzzle of the gun is fastened a light piece of wood which carries the black cardboard screen shown in outline in the figure. A piece of thin sheet copper fastened to the wood has a row of equidistant holes drilled through it, each being one millimeter in diameter with the distance between holes nineteen millimeters. The row of holes is approximately parallel to the axis of the gun. To obtain a brilliant illumination for the holes

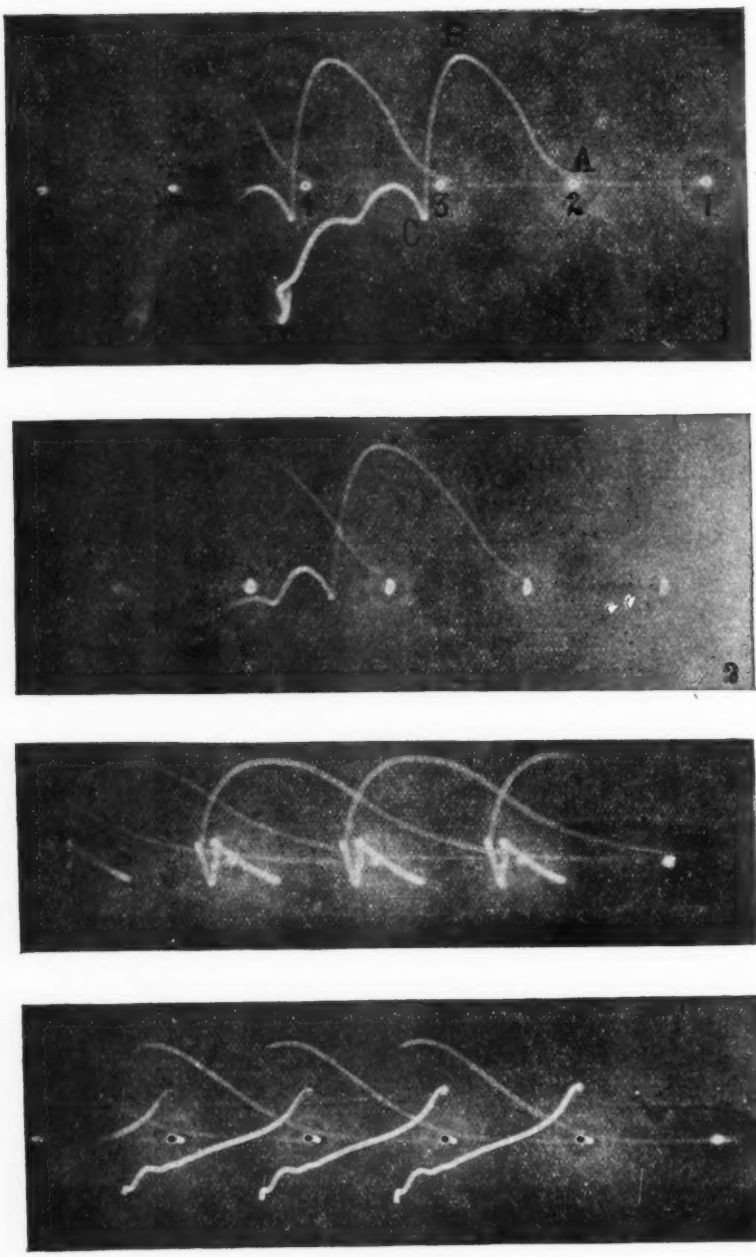

PLATE I.

a mirror reflects sunlight through them to the camera. This method was adopted since more satisfactory results were obtained than with beads. The arrangement has its disadvantages since the size of the curve which can be recorded is practically limited by the size of the lens used in the camera: for should the gun move so far that the projection of a ray through a hole in the screen should fall outside of the lens, the illumination of the hole would not be sufficient to record itself. The lens used in this experiment was over nine centimeters in diameter, being a Dallmeyer portrait lens $3B$ of their catalogue. This size was sufficient to cover the whole motion of this gun during recoil. A similar plan, using a concave mirror instead of a plane one, would obviate the disadvantage mentioned above; namely, the necessity of having a large lens for the camera. In order to have the record of these curves the same size as the curves themselves, the lens was placed half way between the luminous holes and the camera plate. The distance of the lens from the holes was usually about two feet.

THE CURVES OBTAINED.

In plates I and II are shown some of the curves obtained by this arrangement. Referring to plate I, No. 1, the luminous points before firing were in the positions 1, 2, 3, 4, 5, and 6, and during the recoil these points each traced curves as shown. The complete motion of point 1 is the curve $1ABCD$, the other points 2, 3, 4, etc., likewise traced similar curves. The part of the curve $1ABC$ from the origin to the point C is smooth and of the same type in all cases. The other part CD is unimportant and varies with the particular individual holding the gun. The exposure was made as short as possible after firing the gun to cut off this irregular part of the record. The point 1 is nearest the muzzle of the gun; the points 2, 3, 4, etc., are at equal intervals along a line parallel to the axis. It is seen from an examination of the curves that the first motion of the gun is very nearly straight to the rear for a distance of about 20 millimeters, shown by the parts of the curves corresponding to $1A$. Here the point begins to rise rapidly, reaches its maximum at B and falls to C where the recoil proper ends.

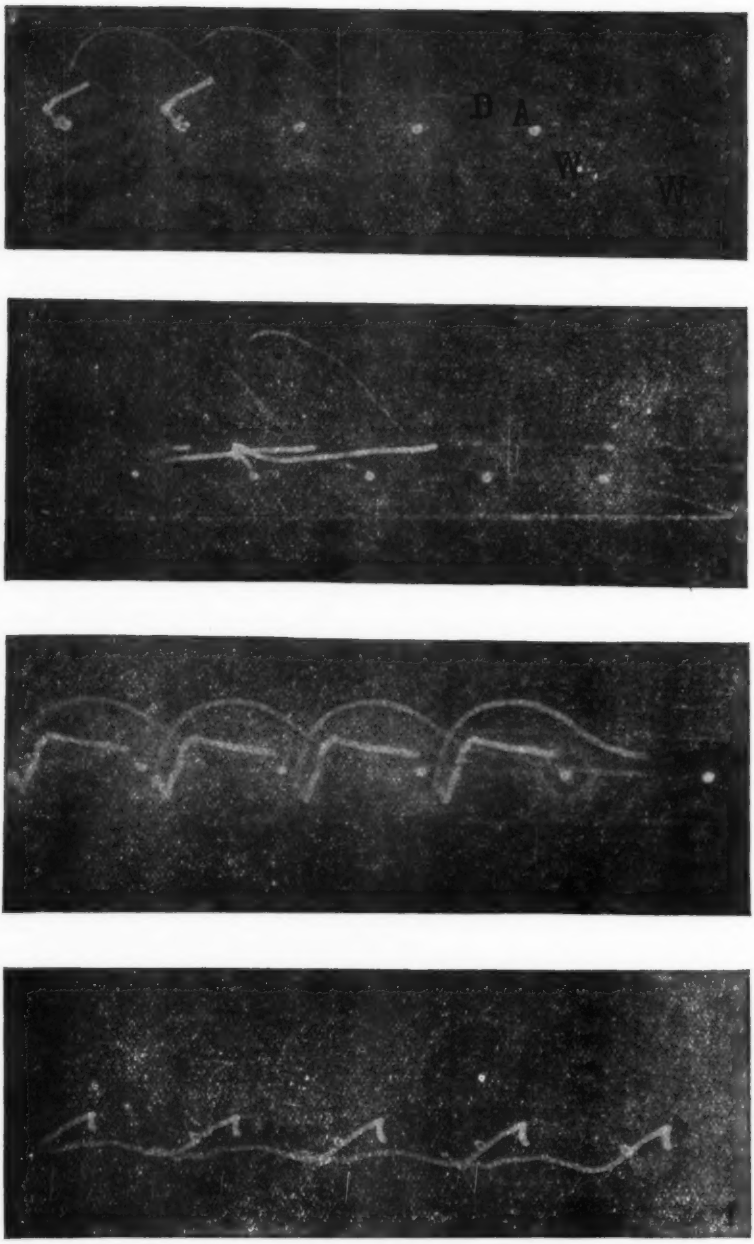

PLATE II.

The intensity of the light at different points indicates the relative velecity which the gun had at these points of its path. During the first period, when the gun moves straight to the rear, the curves are faint in each case, showing that the velocity was great; beyond this, as the gun begins to rise, its velocity diminishes and the curves grow brighter, until at the summit *B* there is a maximum brilliancy. The great intensity of the irregular parts after recoil shows the comparatively slow velocity which the gun has during this period. In plate I, No. 4, and plate II, Nos. 1 and 2, the light was accidentally cut off before the latter part of the recoil path was completed, but appeared again later as shown.

ANALYSIS OF THE CURVES.

Figure 2 represents actual curves taken with the Springfield rifle, from which the instantaneous positions of the axis during its motion can be determined by a simple geometrical construc-

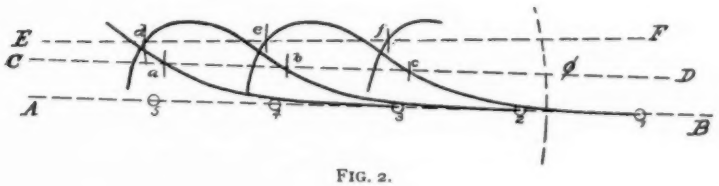

FIG. 2.

tion. The points 1, 2, 3, 4, etc., represent the initial position of the luminous holes, and the right line *AB* the initial position of the axis of the gun. Since the distance between the holes remains invariable, the position of the axis corresponding to any point on any curve, as at *c*, is determined. With the assumed point *c* as a centre, and a radius equal to the distance between consecutive holes on the diagram, describe the arc of a circle cutting the adjacent curve at the point *b*; and with *b* as a centre using the same radius describe the arc cutting its adjacent curve at *a*, and so on for as many curves as are represented. These points of intersections must lie in a right line *CD*, which represents the instantaneous position of the axis for the points considered. In like manner the points *d*, *e*, and *f* are determined by assuming

one of them and constructing the other two, and the line *EF* represents another position of the gun's axis, which shows an appreciable angular displacement, from the initial position *AB*, and indicates that the gun has at this instant a considerable angular velocity about an instantaneous axis at the intersection of *AB* and *EF*.

THE JUMP PROPER.

One of the problems of gunnery is the determination of what is technically called the angle of *jump*. The accuracy of modern high power guns now requires that this angle should be known to at least one minute of arc. The angle of jump may be defined to be the difference between the angle of elevation at which the gun is laid, and the angle of departure at which the projectile leaves the bore, and theoretically varies with each particular gun and mount as well as the angle of elevation itself; and should be determined by experiment in each case. The complete motion of a gun during recoil is theoretically complicated in its character, and the true angle of jump should be carefully differentiated from the remaining motion if we are to obtain the true corrections for our tables of fire. During the short period while the projectile is in the bore, with which we are alone concerned in determining jump, a moment's consideration shows that the path of any point on the axis of the gun is theoretically the resultant of several distinct motions. The powder pressure acting along the axis tends to produce a motion of translation of the gun and its upper carriage with respect to the chassis rails; while at the same time the gun tends to rotate about its trunnions, the gun and upper carriage about its rear part, and the whole amount about the base.

From the above consideration it is evident that if we could trace the consecutive positions of the axes of the gun between its initial position when the gun is laid before firing, continuously until it comes to rest, this moving axis would envelope a curve, the tangent to which at the instant the projectile leaves the bore would be the true angle of departure, and when known would determine the true angle of jump.

EXPERIMENTAL DETERMINATION OF JUMP.

An experiment was tried to determine the portion of these curves belonging to the jump proper, or how much of the curves are traced before the bullet leaves the gun. The method adopted was to attach behind one of the luminous holes a small piece of cardboard so that its edge came just to the edge of the hole without covering it. To this minute cardboard screen was attached a small copper wire seen at *WW*, plate II, No. 1. This wire was carried forward directly across the muzzle of the gun and fastened to a nail in the light board. When the bullet reached the muzzle the wire was struck by it and cut in two, but at the same time the tension on the wire was sufficient to draw the cardboard forward and completely cover the hole. The curve should cease when this happens for this one hole only, while the curves of other holes are made complete. The cardboard passed completely by the hole and thus allowed the curve to begin again. The negatives show these points much better than the print can. The cardboard was originally at *A* attached to the wire *WW* leading across the muzzle. The curve appears again at *D* after the cardboard has passed completely by the hole. The portion of the curve described before the bullet arrives at the muzzle is so short that the only effect seems to be a slight elongation of the whole in the direction of the curve. It may be said therefore that a Springfield rifle does not move appreciably before the bullet leaves the muzzle. Even if the motion were appreciable its direction is such that it is parallel to the axis, and does not affect the aim of the gun. From this experiment the jump of a Springfield rifle is approximately zero, a result to be expected from practice with this gun.

In the case of large guns permanently mounted upon complicated carriages, the jump is often considerable, amounting to several minutes of arc and corresponding roughly to a muzzle motion of one or two inches, and its accurate determination is a matter of importance. On account of the comparatively large complete motions of recoil in such cases, a luminous object like an incandescent lamp upon the gun itself would seem a good

method, and in order to remove the camera to such a distance as to be free from danger of the blast, it would only be necessary to employ a single plane mirror so placed as to reflect the rays into the camera placed at a safe distance in rear of the gun.

RECENT PROGRESS IN OPTICS.

W. LE CONTE STEVENS.

(Continued from page 492).

THERE is no conclusive direct evidence thus far that such luminescence as vanishes instantly upon the withdrawal of light is accompanied by chemical action.

But Becquerel demonstrated long ago, with his phosphoroscope, that there is a measurable duration of luminous effect when to the unaided eye the disappearance seems instantaneous.* Wiedemann now shows that when this duration is considerable, there is generally chemical change. Since duration is only a relative term, it seems highly probable that even cases of instantaneous luminescence, commonly called fluorescence, are accompanied with chemical action on a very minute scale, and that all luminescence is, therefore jointly physical and chemical in character. We have thus color evoked by the direct action of light, which disturbs the atomic equilibrium that existed before exposure, and the manifestation of such color continues only until the cessation of the chemical action thus brought into play.

The influence of very low temperature upon luminescence and photographic action has been studied by Dewar.† The effect of light upon a photographic plate at the temperature of liquid air, —180° C., is reduced to only a fifth of what it is at ordinary temperature, and at—200° the reduction is still greater, while all other kinds of chemical action cease. In like manner, at—80° calcium sulphide ceases to be luminescent; but, if illuminated at this low temperature and then warmed, it gives out light. At

* Becquerel, *Comptes Rendus*, xcvi, 121.

† *Chemical News*, lxx, p. 252, 1894.

the temperature of liquid air many substances manifest luminescence which ordinarily seem almost incapable of it; such are gelatine, ivory and even pure water.

A crystal of ammonium platinocyanide, on the other hand, when immersed in liquid air and illuminated by the electric light, shines faintly when this is withdrawn. If, now, the liquid air be poured off, so that the crystal rises rapidly in temperature, it glows brightly.

Luminescence and Photography.—Photography, like luminescence, is a manifestation of the transformation of energy, most frequently of initial short wave-length. The production of color by photography is nothing new. It was noticed by Seebeck nearly a century ago that silver chloride becomes tinted by exposure to ordinary light, with accompanying chemical change; that if then subjected a long time to red light it assumes a dull red hue, or a dull bluish hue if held in blue light. It is likewise possible by proper selection of luminescent salts to produce a selected series of tints during and after exposure to those rays which are most effective in photography. But such colors cannot be made fixed and permanent. The problem of securing on the photographic plate a faithful and lasting reproduction of the various tints of a spectrum thrown upon it has baffled most of those who grappled with this subject. That it has been fully and quite satisfactorily solved cannot yet be affirmed, but the last few years have brought a much nearer approach to success than an equal number of decades previously. Viewed from the scientific standpoint, the goal has certainly been touched, even if commercial demands are still made in vain.

Stationary Light Waves.—Two quite different methods are to considered in tracing the recent development of this interesting application of optical principles. The first is originally due to Becquerel,* but lately in the hands of Lippman it has been improved and brought much nearer to success than by its originator. It depends upon the production of stationary waves of light. Every one is familiar with the formation of stationary waves upon an elastic stretched cord, and with the acoustic

* Ed. Becquerel, *Ann. de Chemie et de Physique*, iii, xxii, p. 451, 1848.

exhibition of stationary air waves in a closed tube by Kundt's method of light-powders. That similar loops and nodes must be produced under proper conditions by interference of waves of light would appear obviously possible; and so long ago as 1868 Dr. Zenker,* of Berlin, explained the photographic production of color, so far as it had then been accomplished, by reference to stationary light waves. But no definite proof of their production had been brought forward. A few years ago Hertz demonstrated objectively the electro-magnetic waves whose existence had been foretold by Maxwell's genius, and with suitable apparatus stationary electric waves are now almost as readily made evident as are those of sound. Hertz's brilliant success stimulated his fellow countryman, Otto Wiener, to undertake the apparently hopeless task of producing and studying stationary light waves. Wiener's† admirable work excited great interest on the continent of Europe, but it has been singularly neglected in England and America. It is worth much more than a passing notice.

Assume a plain silvered mirror upon which a bundle of rays of monochromatic light falls normally so as to be reflected back upon its own path. The superposition of reflected and direct waves causes a system of stationary waves, but under ordinary conditions these are wholly imperceptible. The nodes are formed upon a series of planes obviously parallel to the reflecting plane at successive distances of a half wave-length. If now we consider a plane oblique to the mirror, it will cut these successive nodal planes in parallel lines whose distance apart will be greater in proportion as the oblique plane approaches parallelism to the mirror. Although a half wave-length of violet light is only one five-thousandth of a millimeter, it is easy to conceive of the cutting plane forming so small an angle with the mirror that the distance between the parallel nodal lines shall be a thousand times a half wave-length. Such would be the case if the inclination of the cutting plane is reduced to a little less than four minutes of arc. The nodal lines would then be one-fifth millimeter apart, and readily capable of resolution if their presence

* Zenker, *Lehrbuch der Photochromie*, Berlin, 1868.

† O. Wiener, *Wiedemann's Annalen*, xl, pp. 203, 1890.

can be manifested at all. Imagine a very thin transparent photographic film to be stretched along the oblique cutting plane and developed after exposure to violet light as nearly monochromatic as possible. Then the developed negative should present a succession of parallel clear and dark lines, corresponding to nodal and anti-nodal bands along the oblique plane, the photographic effect being annihilated along an optical nodal line.

The realization of a photographic film thin enough for such an experiment is quite conceivable when we remember that under the hammer gold is beaten into leaves so delicate that 8,000 of them would be required to make a pile one millimeter thick. By electro-chemical deposit Outerbridge * has made films of gold whose thickness is only one one-hundredth of a millimeter, or one-sixtieth of a wave-length of sodium light. Wiener obtained a perfectly transparent silver chloride film of collodion, whose thickness was about one-thirtieth of a wave-length of sodium light. This was formed on a plate of glass and inclined at a very small angle to a plane silvered mirror which served as reflector. From an electric arc lamp the light was sent through an appropriate slit and prism, so that a selected spectral band of violet fell normally on the prepared plate in the dark room. The developed negative presented the alternate bands, in perfectly regular order, more than a half-millimeter apart. Various tests were applied to guard against error in interpretation, and the existence of such stationary waves was proved beyond all doubt,

These waves, moreover, when polarized light was employed, furnished the means of determining the direction of vibration with relation to the plane in which the light is most copiously reflected when incident at the polarizing angle, and thus of subjecting to experiment the question as to whether the plane of vibration is coincident with this plane of polarization or is perpendicular to it. The former of these views was held by Neumann and MacCullagh, the latter by Fresnel. Let a beam of polarized light fall upon the mirror at an angle of about 45°. If the vibrations in the incident beam are parallel to the mirror, and hence perpendicular to the plane of polarization, those of

* Journal of Franklin Institute, vol. ciii, p. 284, 1877.

the reflected and incident beams will be parallel to each other and hence capable of interference. But if the vibrations of the incident beam are in a plane identical with that of incidence, and hence in the plane of polarization, the vibrations of incident and reflected beams are in mutually perpendicular planes, and hence cannot interfere. Wiener obtained interference fringes when the light was polarized in the plane of incidence, while that polarized in the plane perpendicular to this gave no trace of interference. The theory of Fresnel was thus confirmed experimentally.

Again, the familiar phenomenon of Newton's rings show us that on changing media there is a change of phase of the incident light, else the central spot where the two surfaces come into optical contact would be white instead of black. But there has been difference of opinion as to whether this change of phase occurs at the upper surface of the air film where the light passes from glass to less dense air, or at the lower surface, where it passes from air to more dense glass. In the latter event there should be a node at the reflecting surface. Replacing the silvered plane surface by a lens in contact with the photographic film, Wiener obtained circular fringes with no photographic action at the center, showing the nodal point to be at the point of contact and thus again confirming the theory of Fresnel.

The Infra-Red Spectrum.—Among the splendid optical discoveries of this century probably the most prominent are photography and spectrum analysis, each belonging jointly to optics and chemistry. Photography was at first supposed to be concerned only with the most refrangible rays of the spectrum, but Abney and Rowland have photographed considerably below the visible red. Beyond the range thus attained qualitative knowledge was secured by Herschel, Becquerel, Draper, Melloni, Müller, Tyndall, Lamansky, and Mouton. But our quantitative knowledge of this region began with the invention and use of the bolometer by Langley, whose solar energy curve has been familiar to all physicists during the last dozen years. During this interval the bolometer has been used with signal success by Angström, Rubens, Snow, and Paschen, who have made improvements not only in the instrument itself but in the delicacy of its neces-

sary accompaniment, the galvanometer. The work of Snow particularly, on the infra-red spectra of the voltaic arc and of the alkalies, and that done by him in conjunction with Rubens on refraction through rock salt, sylvite, and fluorite, exhibited the capacities of the bolometer even better, perhaps, than Langley's previous work on the sun. But more recently with the collaboration of several able assistants, and more particularly the great ingenuity and mechanical skill of Wadsworth, the sensitiveness of Langley's galvanometer has been so exalted, and the bolometer connected in such manner with photographic apparatus, as to make it an automatically controlled system, by which an hour's work now brings results superior in both quantity and quality to what formerly required many weeks or even months. Not only is an entire solar curve now easily obtained in a single day, but even a succession of them. It becomes thus possible by comparison to eliminate the effect of temporary disturbing conditions, and to combine results in such a way as to represent the infra-red cold bands almost as accurately as the absorption lines of the visible spectrum are indicated by the use of the diffraction grating. It will undoubtedly become possible to detetmine in large measure to what extent these bands are due to atmospheric absorption and which of them are produced by absorption outside of the earth's atmosphere.

With the diffraction grating, supplemented by the radio-micrometer, Percival Lewis has recently investigated the infra-red spectra of sodium, lithium, thallium, strontium, calcium, and silver, attaining results which accord well with the best previously obtained by those who had employed the bolometer, and which demonstrate the exceeding delicacy of the radio-micrometer as an instrument of research.

The Visible Spectrum.—To follow out all the applications of the spectroscope that have resulted in recent additions to our knowledge would carry us far beyond the scope of a single paper. It is possible only to make brief mention of a few.

For a number of years Rowland has been investigating the spectra of all the chemical elements, photographing them in connection with the normal solar spectrum, and reducing them to

his table of standards, which is now accepted everywhere. The work is of such magnitude that years more must elapse before its completion. It now includes all wave lengths from 3722 to 7200, and of these the list already published extends as far as wave length 5150; or, from ultra violet nearly to the middle of the green.

Through the spectroscope chiefly has been established during the present year the discovery of the new atmospheric element, argon, by Lord Rayleigh and Professor Ramsay; its remarkable property of green fluorescence when the electric spark is passed through it in presence of benzene, by Berthelot and Deslandres; and its association in meteoric iron and various minerals with helium, now proved to be a terrestrial as well as solar element, by Ramsay, Crookes, Lockyer, and others.

With the diffraction spectroscope Rydberg, and Kayser and Runge have discovered interesting relations among the spectral lines of a large number of terrestrial elements, arranging them into series whose distribution manifests chemical relationship quite analogous to that indicated in Mendeléeff's periocic law.

By photographing the spectrum of Saturn's rings, and noting the relative displacement of the different parts of a spectral line, Keeler has obtained a beautiful direct proof of the meteoric constitution of these rings, a confirmation of the hypothesis put forth by Maxwell in 1859, that the outer portion of the rings must revolve more slowly than the inner portion, and yet not satisfy the conditions of fluidity. His work has been repeated and confirmed by Campbell at the Lick Observatory.

The spectro-heliograph devised by Hale has enabled him to photograph, on any bright day, not only the solar photo-sphere and spots, but also the chromosphere and protuberances. He has made some remarkable attempts with this instrument to photograph the corona without an eclipse, unsuccessful thus far, but not without promise of future success.

Polarized Light.—In the domain of polarized light there have been several noteworthy recent researches. Nichols and Snow have shown that calcite, though readily transparent for the brighter rays of the spectrum, rapidly diminishes in power of

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transmission for waves of short period, so that for the extreme violet this power is scarcely half as great as for the yellow. The transmissive power of [illegible] for the infra-red rays, between the wave-length limits of [illegible] and 5.5 microns, has been investigated with the bolometer by Merritt, who reaches the interesting result that the transmission curve for the ordinary ray is wholly independent of that for the extraordinary, the absorption being in general much greater for the former. Several sharp absorption bands are found for each ray. For radiation whose wave-length exceeds 3.0 microns the absorption of the ordinary ray is almost complete, so that calcite behaves for such radiation just as tourmaline does for the rays of the visible spectrum. The independence of the two transmission curves is found to exist also for quartz and tourmaline, these curves for the latter crossing each other twice in the infra-red region.

The application of polarized light to the investigation of internal stress in transparent media was made more than forty years ago by Wertheim, who demonstrated that the retardation of the ray is proportional to the load. An extended series of such experiments has been lately made in this country by Marston, who, besides confirming Wertheim's conclusions, shows that "for small strains at least, the relative retardation in a strained glass body, when polarized light is passed through it in a direction parallel to one of the axes of strain, is measured by the algebraic difference of the magnitudes of those two principal strains whose directions are perpendicular to the direction of the polarized light."

A new substance with double rotatory power, like quartz, has been discovered by Wyrouboff, the neutral anhydrous tartrate of rubidium, which is unique in one respect. The rotatory power of the substance in the crystalline state becomes reversed in solution. This wholly new phenomenon introduces some perplexity in connection with certain molecular theories that have been formulated to account for double rotatory power.

Crehore has ingeniously applied Faraday's principle of electromagnetic rotation of the plane of polarization in carbon disulphide to the photographing of alternate current curves. Every variation in the magnetic field causes variation in the amount of

SPECIMEN OF STUDIO PORTRAITURE.

transmission for waves of short period, so that for the extreme violet this power is scarcely half so great as for the yellow. The transmissive power of this crystal for the infra-red rays, between the wave length limits of 1 micron and 5·5 microns, has been investigated with the bolometer by Merritt, who reaches the interesting result that the transmission curve for the ordinary ray is wholly independent of that for the extraordinary, the absorption being in general much greater for the former. Several sharp absorption bands are found for each ray. For radiation whose wave length exceeds 3·2 microns the absorption of the ordinary ray is almost complete, so that calcite behaves for such radiation just as tourmaline does for the rays of the visible spectrum. The independence of the two transmission curves is found to exist also for quartz and tourmaline, these curves for the latter crossing each other twice in the infra-red region.

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light transmitted through a pair of crossed Nicol prisms. The combination becomes a chronograph with an index as free from inertia as the beam reflected from a galvanometer mirror. The same instrument has been applied to measurement of the velocity of projectiles, with results of exceeding interest to the student of gunnery.

Physiological Optics.—The temptation to dilate upon recent progress in physiological optics has to be resisted. The revision of Helmholtz's great book on this subject was interrupted by the death of the distinguished author, but the last part is now approaching completion under the care of his pupil, Arthur König, who in conjunction with Diederici has done much important work in this domain. The selection of hues for the three primary color-sensations has been slightly modified. Young selected the two extremes of the spectrum, red and violet, together with green, which is about midway between them. The hues now accepted by Helmholtz and those who follow his lead, including the great majority of physicists, are a highly saturated carmine red, an equally saturated ultramarine blue, and a yellowish green, corresponding somewhat to that of vegetation. The red and blue agree with those previously determined by Hering, but the rivalry between the two schools on the subject of color-sensation continues, and perhaps will last through a period commensurate with the difficulty of devising crucial experiments.

Independent theories of color-sensation have been brought out by Mrs. Franklin in America and by Ebbinghaus in Germany. The former particularly is worthy of much more extended notice than can here be given. It may perhaps be quite properly called a chemical theory of vision. Light is always bringing about chemical changes in external objects, and the eye is the one organ whose exercise requires the action of light, while such chemical action is implied in the performance of most of the bodily functions, such as the assimilation of food and the oxidation of the blood. The bleaching action of light upon the visual purple, which is continnally formed on the retina, has been known ever since the discovery of this in 1877 by Kühne, who secured evanescent retinal photographs in the eyes of rabbits. Mrs.

Franklin considers that light-sensation is the outcome of photo-chemical dissociation of two kinds of retinal molecules that she denominates gray molecules and color molecules, of which the latter arise from the gray molecules by differentiation in such a way that the atoms of the outer layer group themselves differently in three directions, and the corresponding action of light of proper wave length gives rise to the three fundamental color-sensations. She develops the theory with much skill, applying it particularly to the phenomena of retinal fatigue and color-blindness. To the objection that there is no direct proof of the existence of the assumed gray and color molecules, it may be answered that Helmholtz himself fully recognized the uncertainty of the assumption that three different sets of nerves respond to the three fundamental color-sensations, and he admitted that these may be only different activities in the same retinal cone. The supposition of three adjacent cones, responding respectively to the three fundamental sensations, is made only for the sake of greater convenience in discussion.

Indeed there is still much for us to learn regarding the nature of color-sensation. Among the yet unexplained phenomena are those of simultaneous color-contrast. The fact that a small brightly-colored area on a gray background appears surrounded by its complementary tint is familiar enough. For its explanation it has been common to assume that there is unconscious motion of the observer's eyes, incipient retinal fatigue, an error of judgment, or fluctuation of judgment. This has been tested by A. M. Mayer, who ingeniously devised methods for showing these contrast phenomena on surfaces large enough to match the colors with those of rotating color disks, and thus to arrive at quantitative statements of their hues. When viewed through a small opening in a revolving disk the subjective contrast color was unmistakably perceptible when the duration of passage of the opening was less than 1-1000th of a second. The same effect was obtained in a dark room with instantaneous illumination of the colored surface by the spark of an electric influence machine. The duration of illumination is thus almost infinitesimal, certainly not more than 1-100000000th of a second. The hypothesis of

fluctuation of judgment is thus shown to be wholly untenable. I have performed most of these experiments, either with Prof. Mayer or separately, and my testimony can therefore be united with his. The case is quite analogous to that of the perception of binocular relief which was once explained as the product of a judgment, but was found to be always possible with instantaneous illumination. Prof. Mayer has devised a disk photometer based on color-contrast, with which the error of a single reading was found much less than with the Bunsen photometer.

The rotating color disk has been applied by O. N. Rood to the determination of luminosity independently of color by taking advantage of the flickering appearance on a rotating disk upon which two parts have different reflecting powers. An extreme case of this is that of a white sector upon a black disc. At a certain critical speed the retinal shock due to momentary impression by white light becomes analyzed into the subjective impression of spectral colors, the duration of the retinal sensation varying with the wave length of the incident light. The law of this variation has been studied by Plateau, Nichols, and more recently with much precision by Ferry, who showed that retinal persistence varies inversely as the logarithm of the luminosity. For a given source of light separated into its spectral components, the yellow is the brightest. For this hue accordingly the retinal impression is shortest, and for violet it is longest.

Under appropriate conditions the after-effect on the retina has a certain pulsatory character, as first noted by C. A. Young in 1872, and carefully studied within the last few years by Charpentier in France and Shelford Bidwell in England. A disc with properly arranged black and white sectors, if brightly illuminated and looked at while revolving at a moderate rate, becomes apparently colored, just as a momentary glance at the sun causes the perception of a succession of subjective spectral hues which may last a number of seconds. The phenomenon in relation to the disc was known as early as 1838, and explained by Rood in 1860. The re-discovery of what has been long forgotten arouses all the interest of novelty. The "artificial spectrum top" devised by Benham last autumn excited interest on two conti-

nents, and was promptly copyrighted by a prominent firm of opticians in England. It would perhaps be equally enterprising to copyright the solar spectrum.

The limits of a single address forbid my touching upon the large and practically important subject of color-blindness. Indeed in both physical and physiological optics much has been omitted that is abundantly worthy of attention. In behalf of my hearers it may be wise to take heed, once more, of the fate of Tarpeia, who was overwhelmed with the abundance of her reward.

PHOTOGRAPHIC MOUNTANTS.

BY PROF. E. VALENTA.*

PLAIN starch paste is the oldest and most universally used paste for mounting albumen prints. It still remains the most simple and cheapest medium for the purpose, and is certainly the least injurious, provided the precaution is observed always to use the paste fresh, never after it commences to become sour.

A different condition, however, exists where the prints are made upon the modern emulsion papers. Where the paper support of these emulsions is not too heavy, they show little or no tendency to curl, and may be mounted wet in the usual manner, a small percentage of glue being added to the paste, care being taken that there is absolutely no acid reaction.

Heavy papers that have a natural tendency to curl, or aristotypes with a high gloss, require to be mounted dry, and require a different paste. A mountant is here required having a greater degree of adhesiveness; at the same time it must not penetrate the paper, or it would destroy the high gloss of the print.

To overcome this difficulty has resulted in the publication of many widely different formulas for mountants in the various photographic periodicals, and in every case it is claimed a perfect mountant has now been discovered.

* Translated from the German and amplified by Julius F. Sachse.

Upon the other hand manufacturers and dealers have put proprietary mountants on the market, and sold them to unsuspecting amateurs at exorbitant prices, although they by no means fulfill the requirements for a photographic mountant.

These requirements are as follows: In the first instance the mountant should have a greater binding power than ordinary paste.

It must show a neutral reaction, or nearly so, and in no case should it show a marked alkaline or acid reaction. Further, it must not contain any substance which will prove injurious to the photographic image, such as the mercurial salts so frequently added to commercial mountants as an antiseptic or preservative.

A useful, safe and practical mountant, must be cheap and easy to manipulate, and be slow to decompose or spoil. For glacé or matt aristo papers it is requisite that the paste shall not penetrate through the paper, else the enameled face of the print, be it glacé or matt, would suffer.

In the photo-chemical laboratory of the K. und K. lehr von Versuchs Anstalt for photography and reproduction processes at Vienna, a large number of formulas and mountants have been tested, with special reference to their composition and fitness for photographic purposes. The deductions from these experiments show the following results:

STARCH MOUNTANTS.—If starch is treated with aqueous alkali under certain conditions it swells and forms a semi-transparent, viscid mass, having strong adhesive properties. This product is variously known in commerce as vegetable glue, glutine, triticine, collodin, etc. Most all of these preparations show a strong alkali reaction, and upon this account are useless for photographic purposes, notwithstanding their great relative adhesive properties.

In cases where the product is neutralized with acid, it proved at the expense of the adhesive properites. Consequently, on account of this effect, all advantages of these vegetable glues over ordinary starch paste are lost when the former is in a neutral condition.

Far superior, for photographic purposes, are mountants composed of starch in combination with the gum-arabic or dextrine.

These mountants have the advantage over all gelatine mountants that they are viscid or pulpy at an ordinary temperature, and at the same time possess a relatively strong adhesiveness.

An excellent mountant of this nature is made as follows, and which answers for mounting ordinary photographs, such as albumen, platinotype, aristo and celloidin prints, as well as glacé or matt aristo prints, in all their variety, as it has the advantage of not penetrating through the paper.

White gum-arabic	35 grams.
Water	100 c.cm.

After the gum is dissolved strain through a piece of muslin to remove any possible foreign substance, then add

Starch	30 grams.

Stir this in a mortar or suitable dish, and heat the whole mass over a water-bath until the paste has reached the required consistency.

The addition of a little white sugar has proven of advantage.

The substitution of dextrine for gum-arabic, somewhat lessens the adhesive properties of the mixture.

Compounds of dextrine, alum, sugar, water and carbolic acid (as an antiseptic) have also proven of service and value in these experimental tests.

A good formula is as follows:

Dextrine	60–90 parts.
Alum	4 "
Sugar	15 "
Water	120 "
Carbolic acid, 10 per cent.	6 "

MIXTURE OF STARCH-PASTE AND DEXTRINE in various forms have of late been brought into commerce and sold for photographic purposes. One of the most widely advertised pastes of this class is one labeled "Concentrated White Paste." This paste represents a viscid white mass, which according to careful analyzation consists of water, starch-paste, dextrine, boracic acid, glycerine, and a small portion of thymol as an antiseptic.

GELATINE OR GLUE MOUNTANTS are absolutely unfit for mounting photographs. As the gelatinous mass has to be liquefied

by heat for use, it readily decomposes, and if diluted to a proper consistency, has the fault of penetrating through the paper.

The simplest method to overeome the latter drawback, and at the same time prevent rapid decomposition, consists in adding to the liquid glue a small quantity of amyl-alchohol (fusel-oil).

Liesegang recommends as mountant for his glacé aristo prints, a paste made from good glue (Cologne glue, free from acid) to be first swelled in water, the surplus water to be poured off, to which is to be added, under constant stirring, one c.cm. of amyl-alcohol for every 30 c.cm. of the dissolved glue. This mountant can be diluted with water. It sticks well, but must be used warm. The disadvantage in its use is the strong smell of fusel-oil that it imparts to the print.

Compounds of Glue and Starch-Paste, to which a greater or less quantity of turpentine is added, possess strong adhesive properties, and have frequently been recommended for photographic purposes.

An excellent mountant of this class can be made as follows: 40 grams of good (Cologne) glue is soaked in 100 c.cm. water and melted over a water bath. When from 80 to 100 C., 40 to 50 c.cm. of dissolved starch is added, the mixture being constantly stirred. When these have united and formed a homogeneous glutinous mass, 10 c.cm. of turpentine is added gradually until the whole mass forms a thick, brownish, sticky liquid.

This mountant, unfortunately, must also be applied warm. The addition of the turpentine, as proven by many experiments, in no manner affects Aristo prints.

Good results, with extraordinary adhesiveness, were obtained according to the process patented in Germany by E. Wiese, of Hamburg. This consists in a liqueaction of gelatine or glue by means of chloral hydrate (D. R. P., No. 77,103).

When gelatine or Cologne glue (a bright-colored, very adhesive glue) is steeped in water and then melted, and a certain quantity of chloral hydrate added, an adhesive paste results of great strength, which has the property of remaining liquid, and, as proven by experience, is well calculated for photographic purposest

A good formula for preparing a mountant of this class is as follows:

Gelatine or Cologne glue - - - -	40 grams.
Water - - - - - -	120 c.cm.

The glue is to be steeped in the water, and then dissolved over a water bath.

Chloral hydrate - - - - -	20 grams.

is then added and the whole mass heated for some time. This results in a clear, sticky fluid, which can be neutralized with a few drops of a soda solution.

This mountant has the advantage, that with its great adhesiveness it does not go through the paper.

Above mountants, continues Herr Valenta, are only to be recommended in cases where starch-paste fails to fill the requirements; for instance, with Aristos having a glacé or mat surface, etc.

As all the above recipes have been carefully tested in actual practice, they may be relied upon without hesitation, in all cases where their use is desirable or necessary.

Postal Facilities.—A post-card, mailed in Madras, on January 4th, 1887, has just arrived in Bombay. Addressed to a photographic firm, in Mt. Road, Madras, it went to its destination on January 5th, and came back stamped "Not at Mt. Road." It is spattered all over with initials and post-marks, showing that it made a number of journeys, all ineffectual. Finally, there is a hole in the centre, showing that it had been put on a hook. On the 24th of May there was evidently a "spring cleaning" in the Madras post office, for the card was then withdrawn from the hook and "Try Bombay" added to the many legends on the card. It reached Bombay on the 28th of May, and was delivered to a well-known firm. The eight-year-old message read as follows: "I would be much obliged if you would take my daughter's photo on Thursday. I leave Madras on Friday morning." Let us hope that the poor girl did not have to wait that long for her picture.

THOUGHTS ON PHOTOGRAPHIC SOCIETIES.*

BY WALTER D. WELFORD.

LIKE many words in our circumlocutory English language, "idle" in conjunction with certain other words or used in a certain form, conveys another idea than that of laziness or indolence. The exact meaning is difficult to express, as it is just one of those indefinable metaphors that we know all about but yet cannot absolutely and exactly resolve; and another point is that the idle thought does not carry with it the idle fellow, for, if that were so, it would convey an utterly erroneous idea as regards myself. So, to make a clear start, let me say that "idle" is used in the sense of random, disconnected, odd, and perhaps curious as well.

Now, the first problem to be faced is, What is a society for, what is it supposed to accomplish? Or to put it in a business-like way, Why do we pay our subscriptions—because some of us do—to a man called the Hon. Secretary? I presume most of us expect to get our money's worth. Now do we? The inevitable individuality of such a question precludes dogmatism, and it can only be considered in its several aspects. To do this elaborately is not necessary, and certainly would be no "idle" task, but a few thoughts I have jotted down in nature's note book may clear the atmosphere a little.

Idle thoughts have a quaint nomadic attribute, and so I find myself drifting into a study of the individual in order to define the intercommunity, and, upon the principle of "tell me the company you keep and I'll tell you what you are," we may get an idea of the society through its members. In so doing, by the bye, we run against a curious fact, that the same kind of men are to be found in most societies.

Jotting them down roughly, they classify into the following species:—

The Novice.
The Know-it-all.

* Read before the Photographic Club.

The Man with a Grievance.
The Orator.
The Old-style Professional.
The Process-monger.
The Artist.
The Specialist.
The Quibbler.
The Please-all.
The Wit and the Frivoller.

The genius "novice," the over-enthused beginner, burning with a zealot's fire of knowledge upon all matters photographic, is a decided feature of society life. He utilizes usually the question box, and is at his best perhaps upon some query as to the cause of spots on his negative, or the reason of certain markings. The remainder of the brotherhood in solemn conclave suggest this, and think that, but the genus "novice" is quite sure that all these ideas give no clue. "Dust on the plates?" Why, he can bring witnesses to prove how often he used the brush. "Developer carelessly mixed?" Then how was it another plate that passed through the same developer was free? No, it's bad plates, that's what it is. Then, after the business is over, he hawks the confounded negative round, and just satisfies himself, at the conclusion of the evening, that either the others know little more than himself, or it's a case of bad plates, which the others are afraid to deal with in view of a libel or slander case following. Of such genus is the "novice," the enthusiast; we cannot do without him, but a little of him goes a long way.

The genus "know-it-all" is closely assimilated to the "old style professional," in fact they are relatives. What *they* don't know isn't worth knowing, but how much they really do know the gods only know. The "know-it-all" is not a safe species to tackle, but he may be readily floored by the "specialist," and it's safer to leave it to the latter. In every discussion the "know-it-all," partakes, and he usually imparts considerable sarcasm flavored with egotism. The formula may be expressed as "equal parts, but a little more of No. 2 if the opponent is under-exposed."

His opinions upon all matters are of the order emphatic and unanswerable. He knows, you don't. *Verb sap.* Curtain. We can settle him off with an Irish proverb, "I'd make money if I could buy him at *my* price and sell him at his own."

But it is an idle thought, for he is extra superfine ingrained, inlaid and ultra rapid, far above the usual scale of chargers, though his own rate for self-advertisement is low.

It is a very short step from the humorous to the pathetic, and in the "man with a grievance" we make the step. He is the victim of a chairman's high-handed tyranny, or of a secretary's overweening superciliousness. Perchance some ignoble, boorish clique has for the present triumphed in a battle for the glorious right. (In this case the definition of right is supplied by the loser.) Nor heaven, nor earth, nor—any other place— can deter him from seeking his unalienable right. Special council at committee meetings, extraordinary general meetings, letters to the press, and perhaps finally an advertisement offering to send a printed pamphlet free of charge to expose and lay bare the iniquitous deed of brutal infamy, all follow in turn. There is a grievance astir in the Society, there is one man o'erflowing with it, and he'll continue to flow until it is put right, until Heaven receives her due, and—well until he gets his own way. Until then there is no sun for him, the moon doth but hide her light in sympathy, and the stars twinkle with indignation at the injustice. A wild fresh breeze from Father Thames is needed to drive away the fog of crass ignorance, and the man will have it even if he has first to filter the breeze through blotting-paper. The earth may cease its assiduous ambulation, the sun go out, the moon may effervesce and the stars form a saturated solution of night-late of silver, but the "man with a grievance" remains. Now, instead of saying "he" remains, we should like to alter the pronoun and make it "his" remains. We would not mind an increased subscription for a few years to cover the expense of cremation. Idle thought, no such luck.

Lives there a man with soul so dead
Who never to his friends has said,
I am an orator.

Your technique, art, I can despise
In wealth of language *my* strength lies,
In oratory.

I twist your arguments about;
Adverb and adjective I throw out,
And beat you.

You say the camera cannot lie,
Admit it if you will, but I
Can, in oratory.

Now we are introduced to the higher flights of imagery, of soulful conceptions of noble things, and enters the "orator," the speaker. He may know nothing of the subject, nor possess the slightest interest in it, but it's a chance to speak, and such chances are never missed by him. "Mr. Chairman and dear friends, this is not a subject to be discussed lightly. The past has brought us face to face with many momentous questions, and we have dealt with them as became the gravity of the situation. There are tides that must be taken at the flood, and there is a time in the affairs of every Society that brings in its train;" and so on just as long as he can fling bald platitudes, rusty old quotations and threadbare conjunctions of phrase and word at our heads. And yet the orator is not a bad sort; a little pompous perhaps, but very harmless. An idle reminiscence will come in handy at this point. It was an orator at work on the black-board describing the rules of composition. He pointed out the foreground and the horizon, and then very foolishly mentioned the middle distance as a question. "And where, gentlemen, is the middle distance?" said he, and for a second looked me full in the face. With becoming modesty I suggested that "perhaps it had gone round the corner for a drink." The suggestion of drink bottled him up, and we got through the paper with more black-board and less oratory.

Enter the "old-style professional." You cannot tell him much. He belongs to the Society more to render than receive help. Tell *him* anything? Why, bless your soul, he took negatives 20x18 before you were born, sir. Yes, and they were negatives too, that a man had to work for, sir. My thoughts always connect the old professional with the wet plate; your new-fangled

mediums he uses for convenience sake, but his heart is true to the dear dead days beyond recall, the days of the beloved silver bath and dirty fingers. There was much to admire in the old school; they have battled through difficulties that we know nothing of now, they are earnest, and have experience behind to back up convictions and opinions. The experience, however, tends toward dogmatic utterance, and there is a repugnance towards the new and novel in whatever direction it appears. It is a purely natural characteristic, this opposition to the new, the outcome of years of practice with the old, and the longer one continues to use one process or one apparatus the more difficult it is to make a change. The "old-style pro." falls in line naturally with the pyro-ammonia brigade, and the sharp, clear, brilliant regiment. Still he is all through a useful member, and the free way he advises and counsels is beyond praise.

The formula for the process-monger is formula. He breathes, he revels in it, and without fresh chemical combinations the world would be dreary and humdrum. No paper read and no discussion pleases him unless some formula is mentioned; then he is interested. "What?" he says, "3 grains pyro, 4 grains sulphite soda, 2 grains bromide potassium, 2 ounces water! Snakes alive, I must try this! Why, my last formula gives only 3 15–17 grains sulphite soda!" And for a time he is happy. But at the next meeting it is some art rot, according to his way of putting it, without a single formula in it, and then he wants to know what the Society is coming to, and suggests a change of President and Secretary, or hies off to kindred spirits to form another Society.

(To be continued.)

On a Rhine Steamboat.—American Boy (to parent) "Mommer, where's your camera? Here's a rare good mountain castle for you to take."

Parent—"I'm jest about tired, son, of snapping at things. I shall have to cave in, I reckon. Why, I took fifty-three yesterday 'fore lunch. I'll have to go slow for a bit or else we'll get taxed for extra baggage, and you see—"

THE TRIALS OF A PHOTOGRAPHER.—III.

IN two papers under above title, published during the early part of the present year, some of the everyday trials and tribulations were given of our friend, Napoleon Bonaparte Smith, the genial photographer of Biddleville, one of the blue-blood suburbs of the Quaker City. A few weeks ago, upon being called to that aristocratic suburban town, as a matter of course the writer called on our friend Smith, who stated that business during the past season had been fairly good, even showing an increase on the right side of his ledger.

In cases where credit had been given, however, collections had been more or less difficult, and on account of this circumstance he could hardly tell what the outlook would be for the holiday season, as many of his Christmas customers heretofore had a credit account with him. But now he had made a radical change in the conduct of his business, in so far as he had determined to stop doing a credit business, and in the future his gallery would be conducted on cash principles, or, as he called it, "A tin-type basis; in other words, cash down as soon as the sitting was made, or when the order was delivered."

He explained this by saying that the ordinary run of tin-type customers, people in the ordinary walks of life, so to speak, when they came to have their picture taken brought the money with them, and handed it out with one hand while they reached for the pictures with the other, and that, strange to say, his greatest trouble and losses were made with what are known as the "best" people; that is to say, his wealthy patrons, who occupied a position in the social circles of Biddleville. These people were the most exacting and capricious as to the work, and almost invariably took affront when importuned for their indebtedness, which they took their own time in settling, and in many cases claiming reductions upon trivial pretexts, or not paying at all.

This state of affairs, together with its attendant worriment, induced photographer Smith to try the experiment of conducting every department upon a strictly cash basis, even if the sittings

should be less; this would certainly counterbalance the losses and expenses incurred in attempting to collect outstanding accounts and overdue bills incident to a credit business.

With this change of base, as it were, in the Biddleville Photographic Parlors, there hangs a tale, which, as photographer Smith is directly interested, will be best told in the words of another,—viz., a veracious commercial traveling agent, whose paternal homestead lies within the exclusive limits of Biddleville, and who states that he was present on the occasion.

It happened in this manner: It appears that the Rev. Ananias Whoopemup, a professional revivalist, accompanied by Bro. Bassoprofundo, a sweet singer of Israel, came to Biddleville during the past autumn, and opened a series of revival meetings in the town hall. A large choir was organized from the local talent, and soon the meetings became both popular and protracted.

The effort proved successful from a pecuniary point, at least in so far as collections and the sale of hymn books went, and it was determined to close the series with a grand rally, for which occasion special invitations were sent out to all, both rich and poor.

A cornetist had been secured from the city for the night. In fact, everything was done to close the revival in a blaze of glory.

Well, the eventful night came, the hall was packed; even the elite of Biddleville were out in force to grace the movement with their august presence. Then came the lesser lights who hang around the outskirts of the social firmament, and thus down to the everyday sort of people, who form the bone, sinew, and brains of our land; prominent among the latter was our camera pusher Smith, who, by the way, had been among the most regular and interested attendants.

Everything went according to program. The excitement was at its height, and rich and poor, proud and humble, were carried away with the exhorter's eloquence, who, as a closing spurt, shouted, "Now all ye men and women who owe no man a dollar and have all your debts paid, arise! arise!"

Immediately every person in the hall was upon his feet, with a single exception. There in the front benches stood the Oldstocks, Nucoms, Munibags, Chargemups, Purseprods, Goldollers,

with the other social magnates, together with every man and woman, all declaring publicly that they were free from debt.

The single exception was our friend Smith. After the audience was seated the contrary question was put by the revivalist, when in response our Aristo-miller, Mr. Napoleon Bonaparte Smith arose, and there he stood solitary and alone.

It is useless to say that this caused some commotion, and after the surprise had subsided, the Rev. Whoopemup said, "Why, Bro. Smith, what do you mean?" "Just what I say," was the reply. "My debts are unpaid; my Stockhouse importunes me, my creditors are restless, and the sheriff is in sight."

Here the exhorter again took the word, and addressing the pyro-mixer, said: "Why, Bro. Smith, you surprise me; you who are one of the leading citizens of this town, conducting the photographic studio, an artist of reputation, a respected citizen, without any bad habits, you publicly acknowledge that you have not paid your debts. There certainly must be some good cause for this. Now, brother, as you have had the courage to openly acknowledge your faults in meeting, if you know the cause, speak out fearlessly, and we will try to help you."

The reply of Bro. Smith was given in a firm voice without a tremor. "My trouble is caused by the inability to make my collections. All of the respectable brothers and sisters in the front rows of benches who just stood up when the previous question was taken are patrons of my establishment; and when I present to them my bill for positives delivered I always receive their negative reply in return."

For a few moments the silence was painful, when the closing hymn was given out, but somehow it lacked the vim of the preceding ones. This was especially noticeable in the vicinity of the platform. Another curious feature was that the meeting dispersed quicker than usual.

So much for the drummer's story. What effect the episode had upon our heliographic artist will perhaps form the subject of my next communication.

J. Focus Snappschotte.

ON THE FORMATION OF THE DOTS OF THE HALF-TONE SCREEN-IMAGE.

BY W. K. BURTON, C.E.

DURING the present year a perfect flood of light has been thrown on this subject through the investigations of Levy, Tallent, Dollond, Gamble, Eder, Bolas, Haddon, and others. The following is an attempt to give, in succinct form, the results of these investigations, and of observations made by myself.

It should be borne in mind that the dots produced by light penetrating the screen correspond not to the small black dots seen in the high lights of the finished print, but to the small white dots seen in the darker parts.

The dots of protective material left on the plate to be etched, should, after development, vary in size, having perfectly sharp outlines.

A hypothetically perfect negative to produce such a plate should show the following characteristics:

(1) The dots should vary in size, from little more than a point, to such magnitude that, overlapping each other in the highest lights, only a minute, transparent aperture is left in the middle of each group of four dots.

(2) All dots should be of the same density.

(3) Each individual dot should be of uniform density throughout; and

(4) The outline of each dot should be sharp and abrupt.

I must here say a few words as to Mr. Bolas' contention that it is not desirable to get a negative in which each dot has a sharp boundary or distinction between black and white. He considers that each dot should have a graduated or vignetted boundary, and points out that, with such dots, and metal plates with films to be exposed from the outer surface, "there arises in development an undercutting which results in something shaped like a mushroom, and it is the base of that solid" (the stalk of the mushroom) "which limits the sharp line of demarcation on the plate when the etching comes on."

Now when such an authority on photo-mechanical work as Mr. Bolas makes a statement so decided, it is not to be lightly set on one side, the more particularly when it is based on work by Mr. Ives, but I believe I am right in saying that at any rate with the processes most used at the present time a better result is to be got by a negative with dots having a sharp rather than a graduated boundary.

The simile of the "mushroom" is distinctly a good one. The reason why this form of dot is not, I believe, suitable for our present processes is that, to make it effective, it must be so strong that the upper spreading part will not drop on and cling to the metal after development (a strength possible with bitumen), or that it be of such a nature that this spreading top can be washed away during development, leaving the stalk in every case intact.

However this may be, all published details that we have of the methods used by the most successful workers indicate an endeavor—conscious or not—to get a dot with a sharp boundary. In the case of negatives that I have myself examined under the microscope those with dots having boundaries the most nearly sharp certainly gave the best results with the fish-glue process.

Of the four characteristics mentioned as desirable in a hypothetically perfect negative:

No. 1. Can be secured.

No. 2. Cannot be secured, but a minimum density sufficient to protect the sensitive film of the metal plate from insolation can be secured, and the ratio between maximum and minimum density can be reduced to a mere fraction of what it is in an ordinary negative.

No. 3. Cannot be secured, but a sufficient density to prevent insolation can be secured to very nearly the extreme edge of the dot.

No. 4. Can to all practical intents and purposes be secured, as I shall try to show.

Each dot is a pinhole image of the aperture of the lens. The shape of the dot is determined by the shape of the aperture to which it approximates.

Each dot consists of a nucleus, from which there is a shading

off on all sides, this shading having a more or less sharp boundary, or abrupt falling off of density at its outline. The nucleus is formed by the "full bore" of light through the aperture of the lens, and an aperture of the plate. Its size is determined by the angular aperture of the lens, the size of the screen aperture, and the distance of the screen from the sensitive film.

The graduated part of the dot is partly the result of penumbra, partly of diffraction. The distance to which penumbra effects will go, depends on the relation of the angular aperture to the distance of the screen from the sensitive film, and may be calculated from a very simple equation. The quantity of diffracted light, as compared with undiffracted light, depends on the ratio between the length of boundary line of a screen aperture, and the area of the aperture—being greater, the greater the relative length of boundary.

This fact points out that more attention should be paid than commonly is to the relative widths of opaque and transparent lines on the screen. We continually hear quoted the number of lines to the inch, but seldom the relative widths of transparent and opaque lines. In fact Mr. Levy seems to be the only investigator who has adequately considered this subject. I believe he tends to the adoption of comparatively wide opaque lines, with a view to increasing diffraction effect. With open spacing (say 80 to the inch) and comparatively thin opaque lines, diffraction effect may be practically neglected.

With close spacing (say 150 or even 133 to the inch) and comparatively wide opaque lines, diffraction is one of the principal causes of the spreading of the dot. With these conditions and a small stop—by the use of which the penumbra is reduced —diffraction becomes nearly the sole cause of the spreading of the dots.

In fact it is impossible to have a true nucleus, and at the same time to have the dots overlapping, by penumbra alone, unless the transparent line is wider than the opaque line. A definite ratio of transparent and opaque line widths, to cause dots to overlap by penumbra only, could be worked out if the following were given: (1) the desirable diameter or diagonal of the smallest

black dot in the negative, that is to say of the nucleus; (2) the diagonal of the smallest transparent dot to be left in the middle of four opaque overlapping dots.

The distance to which light may be spread by diffraction depends almost entirely on the distance between the screen and the sensitive film. The angular aperture has but a slight effect. There is no means of simply calculating this distance.

To determine the distance between the screen and the sensitive plate is one of the most important factors in the work under discussion. Were the matter one of penumbra only, it would be easy (with a screen having the requisite relative width of opaque and transparent lines, to give nucleus, and at the same time to give the necessary overlapping of the dots) to give a simple equation for this distance in terms of the angular aperture, and the size of the screen aperture, the desirable size of nucleus, or smallest dot, having first been empirically determined. But the question is really much more complicated, and it would seem that what is desirable in practice, is an arrangement whereby, after focusing the general image on a very fine ground glass, the screen can be introduced, and the distance between it and the sensitive film can be readily adjusted by a milled head, as in common focusing whilst the dots are examined by the aid of a powerful eye-piece.

The next question is as to how a sharp boundary, or abrupt change from transparency to considerable density, can be brought about. The power to bring this about depends more on the negative process used than on anything else. What is wanted is a process having the quality which I have heard happily described as "safe-edge." The quality of "safe-edge" possessed by a film by such a process may be described as follows: The film will stand the effect of a certain comparatively large amount of light, without any developable effect, but with uniformly increasing light, there is a rapid change (after development) from no density or inappreciable density, to very considerable density.

This property of "safe-edge" is to be found in the wet plate, when the collodion is but feebly bromized and is used ripe, and when the bath is made more acid than for ordinary negative use.

It is commonly stated, concerning most kinds of dry plates, that the reason why they are not suitable for screen work is, either that they do not give clearness enough in the unexposed parts, or that they do not give density enough in the exposed parts. These are not the true reasons. Clearness and density can easily be obtained. What is wanting is "safe-edge."

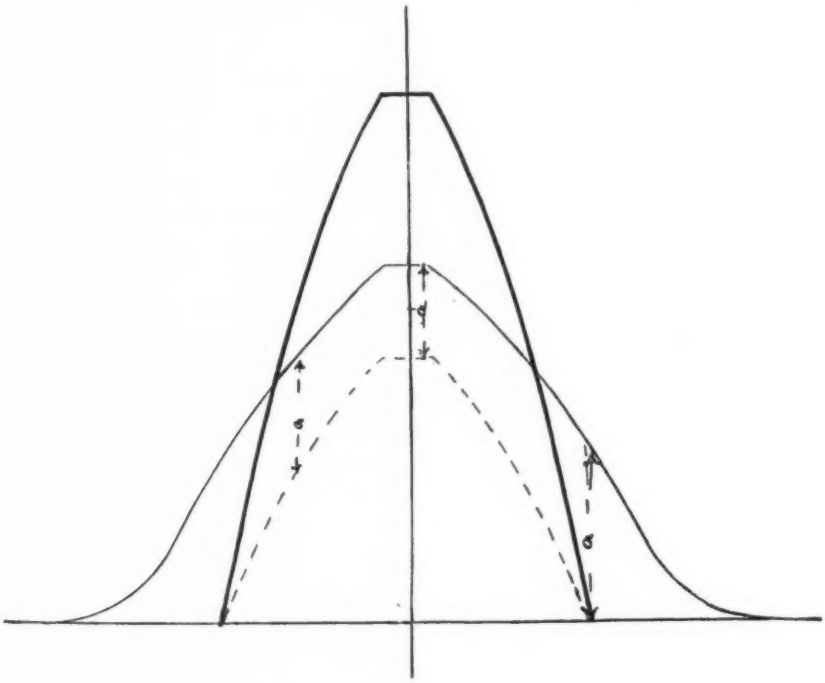

FIG. I.

Whether any of the dry plates now made specially for photo-mechanical work possess this quality in sufficient degree or not, I do not know, as I have not had an opportunity of testing them. That it is possible to produce a gelatino-bromo-iodide plate having the necessary "safe-edge" I am confident, because a good many years ago, whilst experimenting with precipitation emulsion processes, I turned out, accidentally, an emulsion giving plates of the quality desirable for photo-mechanical work. For what these

plates were intended for—general negative work—they were not a success, and no record was made of the formula. They were slow—nearly as slow as a wet plate—and, with any reasonable exposure, gave glassy clear shadows, from which the detail stood out boldly, with abrupt lines. In fact they inclined to give negatives in two hours only.

The density of a single dot of an image on a film with the necessary "safe-edge," may be graphically represented by the thin full-line curve of the diagram (Fig. 1). It will be seen that the transition from transparency to considerable opacity is rapid, but not actually abrupt. It can be made abrupt by the use of a suitable reducer.

The reason why a suitable reducer has the effect here indicated is that it does not reduce the intensity proportionately, but on the other hand tends to remove a constant amount of deposit from every unit of surface area on which there is the necessary deposit. The tendency is the same with all negative processes, but is greater with the deposit *on* the film, as with a bath plate, than with the same in the film as with an emulsion plate. Hence one more reason why a wet collodion plate is to be preferred to a dry gelatine plate.

Supposing the amount of deposit removed to be truly uniform per unit of area on which there is sufficient deposit, and the amount removed to be represented by A in Fig. 1, the dotted line will represent the curve of density after reduction, and it will be seen that in this case the transition from transparency to density is actually abrupt.

After reduction, it is likely that the smaller dots may be lacking in density, and intensification becomes necessary. Intensification is not just the converse of reduction, because in intensification the increase of density is not constant for unit area, but is proportionate (or nearly so) to the original density.

We thus get, assuming that the process doubles the density, the thick full line (Fig. 1) as representing the curve of density of a dot after intensification.

A comparison of the three curves will show that reduction, followed by intensification, is not a mere undoing and doing again

of work, and is not, therefore, the folly that many have supposed it to be. By the two processes, a curve of density is got that cannot be got by any other known means.

Although the transition from transparency to opacity is abrupt, the curve does not rise perpendicularly from the horizontal axis, and the light passing through the extreme edges cannot be sufficient to insolate the film on the metal plate through its whole thickness. The only result is, however, a dot, after development, of a section somewhat approaching that shown in Fig. 2, in

FIG. 2.

which the black shaded part is the film dot. This is very different from a mushroom section, and such a dot can well stand on its own base.

Lateral chemical action and irradiation have both been mentioned as causes for the spreading of the dot, and probably they do have some small effect, but in practice this effect may be neglected. How inappreciable it is is shown by making the negative with the screen in actual contact—a dry plate being, of course, in this case used. Irradiation and lateral chemical action are as great in such a case, as with the screen some distance removed —greater indeed—yet their effects are not perceptible. This is in copying from a print, as is usual in half-tone work, the total gradation of light being comparatively small. Were a screen negative made directly from nature, with the great range of light exhibited, irradiation and lateral chemical action would probably show very appreciable results in the highest lights.

Ink stains or writing may be removed from books or prints by applying hydrochloric acid diluted in five or six times the quantity of water and allowed to remain on the spot a minute or two before being washed off with clean water. A solution of oxalic acid, citric acid and tartaric acid is also effective and harmless.

PHOTOGRAPHY IN THE CHINESE WAR.

BY SHYOZABARO TOTANI, CAPTAIN OF INFANTRY.

LAST year, as soon as the Imperial declaration of war had been made, the surveying officers of the War Department decided to organize a complete photographic staff for the occasion, and as it seemed likely that the military authorities would order a part of this staff to set off at once with the first army corps, we were ready and awaiting orders. At this stage of the war, however, for some reason the government decided not to permit any to go to war except the men in actual fighting service. We were all disappointed, and all the preparations seemed to be in vain. In all Korean conflicts, and on the Yellow Sea, on land, and on water, our country was constantly victorious. At this time the second army corps was prepared to take the field; His Imperial Majesty's headquarters were removed to Hiroshima, where all military movements were decided upon. At this time, and without any warning, we received a telegram from headquarters to send to Hiroshima a photographic staff, consisting of not more than ten persons. The preparations had to be hurriedly made, and we took only a 12 x 10, and a cabinet outfit with all necessaries for developing, printing, etc. The staff, consisting of nine persons, Messrs. Ogura, Murayama, Tabuchi, Yenuma, myself, and four coolies, hurried to Hiroshima, from where we expected to be sent off along with the second army corps. There were many difficulties in the way, of which the first and greatest was, that as photography is not recognized as a department of an army in the field it was considered by military men, with a few exceptions, as a matter of no importance in time of war, being merely an amusement; besides only a few knew that we constituted a photographic staff of the army, the majority took us to be a party of professionals. However, this last-mentioned misunderstanding gradually passed away, and the importance of photography in connection with war was at last recognized.

Although the first transportation of the second army corps took place in the three days from the 17th to the 19th of

October of last year, the transportation of our staff was postponed until the 23d of the same month, when the second transportation took place, and on the 28th we arrived and landed at Hwayuan-kow, China, where we met the army commanding department. From this department we received what it was deemed necessary to carry along with us, namely, one day's supply of uncooked rice, three days' supply of ready-made food, blankets to protect us from the cold, a tent, some waterproof paper, and three meals besides. All these provisions, along with the photographic apparatus, were, of course, too heavy for our four coolies to carry, so we made an application to the commanding department for track wagons, and eight extra coolies. Our application was favorably received, and at last we had all conveniences for traveling.

Getting two days in front of the commanding department, we started from Hwayuan-kow, and at Hishikwa we came up with the first division, and had the pleasure of being present at the engagement at Kinchow and Port Arthur. After this we were attached to the second army corps and despatched to Weihai-wei. During all our movements we kept our equipment as light as possible by carrying nothing besides the apparatus actually needed for photography. We penetrated into the actual engagements, where we were under showers of bullets. We regret that in spite of making all possible efforts, the results are not so good as we had hoped for. The reason is that we had only one camera, a 12 x 10 size, to be relied upon, and nearly all the engagements were in the early morning before dawn, and their duration was so short that they were finished before the break of day. Besides this, the strong wind and feeble light during the severe cold season were a great source of trouble, which very often compelled us to be satisfied to take a very limited portion of space. After the capture of Port Arthur, I made a proposal to headquarters for a further extension of the staff, and sent Mr. Ogura back to Japan to prepare another outfit for 12 x 10, so as to divide the photographic staff into two parties. We were too late, however, for the day when Mr. Ogura came back to China with the new outfit, and arrived at the commanding department,

was the day when the Chinese Northern Squadron surrendered, and sometime before that Weihai-wei had been totally reduced.

I wish to say a few words about the development of negatives and printing during that time. The difficulties we found in these two manipulations were greater than we had ever dreamed of. The exposures were made in feeble light, in most cases quick exposures being of course necessary, and development was carried out in a room bitterly cold, with imperfect apparatus, so that in the case of shutter exposures two or three hours were occupied in development. During this time the developer froze into ice, as we had not much fuel to keep the room properly warm. All day time was occupied by taking pictures and printing, so we were compelled to develop and tone in the evenings, and often we worked through the whole night. As to the printing, many hours were needed in the poor light we had. Moreover, it was very difficult to obtain any pure, or even nearly pure, water. To get water we had to send some miles up the mountain, or to melt ice from neighboring ponds. The water froze very rapidly, so that at times manipulation was almost entirely beyond our control. In some cases the prints, after toning and fixing, being spread out to dry, became frozen, small grains of ice forming all over them in spite of the room being kept as warm as we could keep it. In short, the effect of a cold climate resulted in such difficulties as we had never imagined.

On the other hand, one thing very convenient was the dark-room. We added a dark tent to our equipment, but only used it twice, once at Hwayuan-kow, and once at Kindiow. Ordinary Chinese houses are made of stone or brick, and to each room there is only a small window, and half the room has no flooring. These we made for waste water. By shutting the window and hanging a blanket at the entrance we had quite a comfortable dark-room, or rather the Chinese houses are dark-rooms in themselves. What I have described are a few of the experiments we met with during the war. Concerning details, I hope the two experts, Messrs. Ogura and Murayama, will write to you at some future time.

In any case, though we got no good results, it may be worth

while to make it generally known that our army had a regular staff of photographers, organized to make photographs during actual battle. The facts will testify to the progress of photography in our country, and we shall have records of this historical war for all times.—*From the Shashin-Sowa.*

Absurdities in Art.—In the gallery of the convent of Jesuits at Lisbon there is a picture representing Adam in Paradise, dressed in blue breeches with silver buckles, and Eve with a striped petticoat. In the distance appears a procession of Capuchin monks bearing the cross. In a country church in Holland there is a painting representing the sacrifice of Isaac, in which the painter has depicted Abraham with a blunderbuss in his hand, ready to shoot his son. A similar edifice in Spain has a picture of the same incident, in which the patriarch is armed with a pistol. At Windsor there is a painting by Antonis Verrio, in which the artist has introduced the portraits of himself, Sir Godfrey Kneller, and May, the surveyor of the works of that period, all in long periwigs, as spectators of Christ healing the sick.

A painter of Toledo, having to represent the three wise men of the East coming to worship on the nativity of Christ, depicted three Araloan or Indian Kings, two of them white and one black, and all of them in the position of kneeling. The positions of the legs of each figure not being very distinct, he inadvertently painted three black feet for the negro King, and three also between the two white Kings; and he did not discover his error until the picture was hung up in the cathedral. In another picture of the adoration of the magi, which was in the Houghton Hall collection, the painter Brughee had introduced a multitude of little figures, one of which was accoutred in boots and spurs, and another was handing in as a present a little model of a Dutch ship.

Oil Marks on Wall Paper.—It will interest housekeepers to know that oil marks on papered walls, against which thoughtless persons have laid their heads, may be removed by making a paste of water and pipe clay or fuller's earth, and laying it on the surface without rubbing it on, else the pattern of the paper may be injured. Leave the paste on all night. In the morning it may be brushed off, and the spot will have disappeared.

The Editorial Dropshutter.

1895, A Retrospect.—The current number of the AMERICAN JOURNAL OF PHOTOGRAPHY completes the sixteenth volume of the series A full and comprehensive index will be furnished with our next number.

The past year, while it has been a more or less successful one all over the country for the professional photographer who kept his prices steady and maintained a healthy competition, upon the other hand has witnessed a ruinous rivalry among photo-mechanical establishments which wiped out all profits.

For photographic societies the year proved a tempestuous one, and most all in this country have had more or less of a struggle to maintain their existence,—retrenchment and strict economy have become the rule with them all.

In journalistic circles there is but little to report. One of our contemporaries has suspended publication during the past year; another reduced its subscription one-half, and a third announces a change in its editorial staff with the coming year. Another matter that has affected the photographic press is the peculiar ruling of the postal authorities, forbidding the mailing as second-class matter of magazines illustrated with mounted photographs.

Death has also been active among writers on photographic subjects, notably in England. The last and saddest blow was the removal of J. Traill Taylor, long the talented editor of the *British Journal of Photography*.

So far as the AMERICAN JOURNAL OF PHOTOGRAPHY is concerned, under the conservative course of its management the list of subscribers has more than maintained its own, and the advertising public, recognizing the value of the periodical and its extended circulation, has steadily increased its patronage during the year.

For the coming year the same course will be pursued in both editorial and business departments,—to keep and maintain the confidence of both readers, patrons, and advertisers.

A prompt renewal of subscriptions will be appreciated by the management and encourage the editor.

Photo Colortype Company.—According to the *Inter-Ocean*, of Chicago, Ill., a company has been organized with a capital stock, $25,000; manufacture of photo-plates; incorporators, A. J. Pflaum, H. Spiesberger, Leopold M. Starn.

A Call.—A few weeks ago we sent out letters to about four hundred photographers in the State, to see if we could get an expression as to how many would assist in organizing a Photographers' Association for Pennsylvania. Our list being old we undoubtedly missed a great many, and to those we will say, there will be a meeting of the photographers in Harrisburg about the first week in February, 1896, for the purpose of organizing. If you are willing to assist drop us a line, and to those who received letters there are quite a number yet to hear from, although we have received a great many favorable replies Please have your answers all in by the 20th of December, as we must publish the date of meeting in the January JOURNAL. Fraternally yours, J. Will Kellmer, Hazelton, Pa. ; E. E. Seavy, New Castle, Pa.

A novel feat was performed at the Diamond Ice Company's works in Newport, R. I A plate of ice was stood on edge just as it was taken out of the tank, and behind this half a dozen persons took their positions, while on the other side a photographer posed his camera. The features could be seen distinctly through the ice.

Obituary.—Amongst the occurrences of last month we announce with unfeigned regret the death of Mr. Thomas C. Roche, the veteran expert photograper. Mr. Roche began in the old days ; he was a Daguerreotyper, and followed the armies during the war, making views, etc. He followed up his profession to within a week of his death, keeping pace with every advance, and perfectly up to date in every detail. His nature and disposition was most genial and kindly, and any brother photographer was welcome to draw from his vast store of information and experience. He leaves a host of friends to whom this notice will bring real sorrow, and from whom his relatives will receive heartfelt sympathy.

In Memoriam.—Just as we are going to press the sad news reaches us of the death of J. Trail Taylor, of London, England, for so many years editor of the *British Journal of Photography*. Mr. Taylor died at Tavus, Florida, where he had gone but a few weeks before to recuperate his shattered health. With the death of Mr. Taylor the photographic press has suffered an irretrievable loss. An extended notice will appear in our next issue.

Fire Among Chemicals.—Stock and apparatus of the Electro-Phototype Company badly damaged.—Just after the workmen had left for the day fire broke out, Monday, Nov. 11th, on the fourth floor of the building at the northeast corner of Sixth and Chestnut streets, and before the flames were extinguished damage to the estimated extent of $5000 was done to the buildings and contents. The fire had its

origin in the photographic room of the Electro-Phototype Company, and burned through to the fifth floor, which also was occupied by the firm. There was a considerable quantity of new work destroyed.

Gruesome Photography.—Early in November, a terrible crime was committed by a negro fiend, near Tyler, Texas, and he was soon captured by a deputy sheriff, but on the way to prison was taken from the custody of the officers by an infuriated mob, who dragged him to the public square of Tyler. An iron rail was planted in the centre, to which the negro was chained and burned to death, the husband of the murdered woman applying the fatal match. A curious feature of this horrible affair was the impressment of the local photographer to photograph the scene; the result was a series of six pictures, which form a modern human document of force and intensity. Picture No. 1 shows the capture of the prisoner at Kilgore. In the foreground are seen the deputy sheriffs, "Wig" Smith and Mr. Tarbutton, who had him in charge, and from whom he was forcibly taken a little while after this picture was made. At the time of the taking of this plate, the mob surrounding the officers and the prisoner had not been joined by the crowd from Tyler, and they were still his custodians. The crowd demanded that Hilliard stand for his photograph, and the idea seemed to please him, for he imagined that it was a grand and good thing for a negro to be made so much of.

The second photograph shows the prisoner in the little wagon in which he was eventually carried to Tyler. He is in charge of deputies "Wig" Smith and Tarbutton, and on the front seat, with his head turned so that his eyes are riveted upon the black brute who despoiled him of his treasure, sits the heart-broken husband of poor little "Becky" Bell. On the rear seat with the prisoner is ex-constable Meadows, who was prominent throughout the entire affair. The wagon, when this picture was made, stopped along the road near the scene of the murder, and afforded Mr. Irons opportunity to make his negative. During the taking of the picture Hilliard sat as rigid as a statue and remarked that he had never seen a good picture of himself and wanted this one to be a perfect likeness, as he wanted to use some of them.

But before the third photograph in this fatal series was made exciting events transpired, and the colored brute who rode for a time in safety in the custody of the officers had seen his guards overpowered in the twinkling of an eye. He had been so roughly handled himself in the melee that he looked for little mercy at the hands of the captors of his captors.

The third plate was made when the cavalcade escorting the prisoner

reached the public square of Tyler. Farm wagons, cotton trucks, buggies, spring wagons, ponies, horses, mules, burros—everything in the way of vehicle or quadruped that could carry humanity—fell in with the columns as it marched from the little creek where the court was held to the public square at Tyler. Five thousand people were in line when it reached there. Twice around the square rode the hapless prisoner, while the little bunch of men in the centre, as shown in this picture, were erecting his gibbet. He did not pose in this picture, and took no interest in it, even if he knew it was being taken.

The fourth plate was made just at dusk, when a drizzling rain began, and shows the culprit on the improvised scaffold.

In the fifth plate, which is a particularly striking photograph, the condemned man is seen, surrounded by his captors, praying. He was again triced up with heavy chains, and the photographer prepared to make another plate.

The sixth illustration of the series was made after the enraged and distracted husband applied the match. The picture shows the beginning of the fire that consumed him, and when it was taken there were four or five thousand men, women and children standing in the square, or occupying seats of vantage in the second-story windows or upon the substantial frame and iron awnings that prevail in every Southern town.

Night had set in by the time the fire was fairly started, and photography was out of the question.

Removal.—The Scovill & Adams Co., of New York, on or about January 1, 1896, will remove from their old location in Broome Street, to more commodious quarters on East Eleventh Street, five doors from Broadway. One of the features of the new store will be a specially-constructed dark-room. For the use of patrons and friends this will be conveniently situated, and on the roof of the building there will be a commodious skylight, with light facing north, for experimental and testing purposes.

Enterprise and Success.—Warmkessel & Co., the enterprising photographers of Allentown, Penna., lately opened a new ground floor gallery. This studio is one of the finest photographic establishments in the eastern part of the state, equipped with all the latest approved appliances. The occasion of the opening was made something of a general celebration. Several trolley cars were hired, and with bands of music, went over the suburban roads, to Bethlehem, Catasauqua, Seyfert's Bridge and other outlying points. The cars were tastefully decorated and bore placards setting forth the enterprise of the Allentown photographers.

Camera Club Officers.—The Camera Club, of Akron, O., held its regular monthly meeting Tuesday evening, Nov. 14th, at the home of Miss Maggie Mitchell. The following officers were elected for the coming year: President, Mr. H. B. Houghton; viee-president, Mr. Gibbs; secretary, Miss Maggie Mitchell; treasurer, Mr. H. McGill. Mr. Houghton entered at once upon his new duties, and appointed the following committees: Executive Committee, Mr. Benner, Mr. Canfield, and Mr. Williamson; Lantern Slide Committee, Mr. Terrass and Mr. Frank; Outing Committee, Prof. Knight, Mr. McGill and Mr. Gibbs. Prof. Knight had prepared an excellent paper on "Photography with a Purpose." It was decided to have a circulating library composed of the leading photographic magazines and papers. The club intends holding fortnightly meetings during the months of January, February and March, in order to accomplish an extra amount of work. The display of views and lantern slides was unusually good.

Dry Plates for Process Work.—Mr. George S. Hutchinson, of Randolph, Vermont, writing upon this subject to Mr. John Carbutt, the veteran dry-plate maker, under date of Nov. 19th, 1895, states: "A short time ago I ordered a trial box of your "Process Dry Plates," and thinking, perhaps, you would like to know how I succeeded with them, I venture to write you. I am highly pleased with them, and hereafter the wet process will be a "back number" with me. As to their wearing qualities as negatives, I had an order for six cuts of the same subject, and after one negative had printed them, it looked just as well as ever, and would have lasted indefinitely. That the dry process is always ready for use, and can be developed a longer or shorter time after exposure, and is devoid of much of the unpleasantness of working, and requires much less exposure, is enough to recommend it to anyone doing line or half-tone work."

Camera Club Organizes.—The Camera Club section of the Ethical Society, Milwaukee, Wis., organized, Nov. 15th, as an independent society, and the following officers were elected: President, V. M. Moore; vice-president, C. R. Gilman; secretary, B. C. Gutenstein; treasurer, R. S. Baird. The board of directors comprises the officers with E. M. Katz. The club will build working rooms in the Ethical Society building.

The American Annual of Photography and Photographic Times Almanac for 1896. Edited by Walter E. Woodbury. Published by the Scovill & Adams Company of New York, 423 Broome Street, New York.—This welcome annual is received just as we are going to press. An extended notice will appear in our next issue.

In the Twilight Hour.

A TEAR needs no translation.

ALLOW thyself to complain of nothing, not even of the weather.

NO MAN has learned how to rest until he has learned to live one day at a time.

IF there is anything that is simply inane, it is the handshake that is simply proper.

FALL the first step and you are exceptionally lucky not to fall the whole flight.

THERE is nothing in the universe that I fear, except that I may not know all my duty, or may fail to do it.—*Mary Lyon.*

ONLY follow the light you have. Be true to the starlight, and it will bring you to the light of the sun.—*Margaret Bottome.*

FOR she's one o' them things as looks the brightest on a rainy day, and loves you best when you're most in need on't.—*George Eliot.*

"HE that watereth shall be watered also himself." The teacher or preacher does poorly, indeed, who finds not rich reward for his time and effort in the dispensing of his own spiritual life, while trying to benefit others.

WHETHER any particular day shall bring to you more of happiness or of suffering is largely beyond your power to determine. Whether each day of your life shall give happiness or suffering rests with yourself.—*G. S. Merriam.*

MAN is a perpetual receiver. His true likeness must be painted with outstretched arm and upturned palm. Prince or beggar, it is all the same. Both are supplicants; turn down the hand of either and he will die.—*Exchange.*

NIGHT is evil's day.

SORROW is the school of faith.

ALMOST saved is altogether lost.

IT is the wolf in sheep's clothing that has the sharpest teeth.

IF you want to lose your own ache relieve some one else's aches.

ONE of the first privileges of every man is the right to live without worry.

WE cannot be at peace with God and be in contention with everyone about us.

GOD does not grant blessings according to our merit, but according to our need.

THE world is in great danger of being talked to death. Let us *do* something for it.

THREE expressions tell the history of the prodigal son: sick of home, homesick, home.

TURN about, and in place of trying to make yourself happy, try making the other fellow happy.

MAN fell through an attempt to be independent; man is recovered through a willingness to be dependent.

WORDS are pictures of thoughts, the heart is the negative. "Out of the abundance of the heart the mouth speaketh."

YOU must desire to improve your heart, and so become good. You must desire to improve your head, and so become well informed. But you must desire first to become good. That is the first and great end of life, That is what God sent you into the world for.

BARGAIN LIST.—DEC., 1895.

PORTRAIT CAMERAS.

[For Lenses see Special List.]

1—11x14 Portrait Camera, with 8x10 attachment, . . . $60 00
1—14x17 D. S. B. Portrait Camera, 40 00
1—5x7 Victoria Camera, 4 ¼-lenses, ... 18 00
1—5x7 Victoria Camera, ... 8 00
1—5x7 Victoria Camera, ... 9 00
1—5x8 Stamp Camera 15 00
1—5x8 Wet Plate Stereo. Camera, 3 holders, ... 20 00
1—14x17 Portrait, 2 holders, . . 25 00

VIEW CAMERAS.

1—5x8 Genessee Outfit, 3 extra holders 13 00
1—8x10 N. P. A. View Camera and 1 extra holder 10 00
6—⅝ Scovill light-weight film holders, each 1 00
1—4x5 Universal Camera, 3 holders, focal plane shutter, Oithoscope lens 30 00
1—8x10 New Model Camera, 6 holders, lens and tripod . . 18 00
1—Takiv Magazine Camera, . . 2 50
1—Peep-a-Boo Camera, ... 2 50
1—5x8 Blair Camera, with 6½x8½ extension and 12 holders, . . 25 00
1—4¼x5½ Blair Rev. Back Camera, 6 holders and case, . . 22 50
1—6½x8½ View and 2 holders . 8 00
1—4x5 New Model Improved Camera, 3 holders, ... 11 90
1—5x8 New Model Camera, . . 10 00
1—6½x8½ Novelette Camera, new, ... 20 00
1—5x8 Blair Single Swing View Camera 15 00
1—6½ x 8½ American Optical Co.'s View Camera, ... 20 00
1—5x7 Blair Rev. Back Camera, new 25 00
1—5x8 Boston Rev. Back Camera, new 25 00
1—¼ Eclipse Outfit, ... 2 00
1—5x8 '76 Camera, Holder, Tripod, and Case, ... 23 00
1—5x7 View Camera, ... 7 00
1—5x8 Blair Rev. Back Camera, and 4 holders, ... 25 00
1—Student Camera, complete . . 1 50
1—5x7 New Model Improved and 3 holders and case, ... 11 00
1—14x17 Ideal Camera, holder, tripod, Orthoscope lens and case, ... 100 00
Without lens, ... 40 00

HAND CAMERAS.

1—C Daylight Kodak 15 00
1—No. 1 Kodak, ... 10 00
1—A Ordinary Kodak, new, . . 5 00
1—5x7 Folding Kodak, new, . 50 00
1—4x5 Climax Detective, new, . 18 00
1—4x5 Turnover Detective, new, 15 00
1—4x5 Montauk Detective, new, 18 00
1—4x5 Hawkeye " . . . 6 00

ACCESSORIES.

1—Anthony's Electric Retoucher, 15 00
1—Iron Centre Camera Stand, . 2 00
1—Seavey Balustrade 10 00
1—Seavey Vase 2 00
10—6½ x 8½ Printing Frames each, ... 35
1—14-in. Drag Burnisher, . . . 5 00
3¼x4¼ Washing Boxes, each, 50
1—8 ft. Show Case 12 00
2—Large Oak Show Frames, each 5 00
1—8x10 Knickerbocker Stand, . 4 00
1—Corner Chair, Velvet, list $20, 10 00
1—Cooper Enlarging Bromide Lantern, 8 in condenser . . 35 00
1—11-in. Acme Burnisher. . . . 12 00
1—14-in. Eureka Burnisher, . . 15 00
1—15-in. Improved Eureka Burnisher 25 00
1—Acme Print Trimmer, new, . 10 80
1—Baldwin Print Cutter, new, . 12 00
Lot of Picture Mats. Write for particulars.
1—14x17 Printing Frame, . . . 1 25
1—18x22 Printing Frame, . . . 2 50
1—11x14 Printing Frame, . . . 1 00
1—8x10 Printing Frame, ... 40
1—14x17 Adaptable Washing Box 4 50
2—6x8 Children's Backgrounds, 3 00 and 4 00
1—Wall Accessory, ... 4 00
1—Daisy Foreground, ... 4 00
1—Seavey Swiss Cottage 8 00
1—Osborne's Rock Accessory, . 10 00
1—Osborne's Pillar Accessory . . 15 00
Lot of second-hand backgrounds, 8x10 and 6x8, $3.00 to $6.00; write for particulars.
Peerless Varnish Pots, each . . . 40
Full line of Packard Brothers' Grounds *in stock*. Interiors $5.00; exteriors, $4.00.
3—Junior Ruby Lamps, each, . 60

1—4¼x5½ Negative Box . . . 35
1—Walmsley Reversible Finder . 2 50
1—Card-size Burnisher 3 00
1—Magic Camera Stand, ... 7 00
1—22x28 Moorehouse Display Album, ... 10 80
1—Williams Flash Lamp, ... 75 00

Bargains in Lenses.

1—8x10 Bausch & Lomb Rapid Universal Lens,
With B. & L. Shutter . . 37 00
Without Shutter 30 00
1—8x10 Steinheil Anti-planatic Lens; list $50 . . . . . 38 00
1—8x10 S.W series Voigtlander Wide Angle Lens; list $65.50 45 00
1 Set ¼ size Lenses 9 00
1 Set 1-9 size Lenses 15 00
1—½ size Voigtlander Portrait . 25 00
1—6½x8½ LeClaire Lens, . . . 12 00
1—¼-Size Portrait Lens, ... 4 00
1—¼ Voigtlander Lens, ... 9 00
1—8x10 Eagle R. R. 20 00
1—16x20 Darlot 20-A 35 00
1—6½x8½ Gundlach and Shutter, 50 00
1—Extra 4x4 Harrison Portrait. 30 00
1—¼ H B and H Lens, ... 3 00
1—3 B Dallmeyer lens for cabinets, ... $130 00
1—½-Size Dallmeyer lens for cabinets, ... 50 00
1—5x7 Euryscope Lens, Prosch Shutter, ... 35 00
1—6½x8½ Gundlach Single Lens 3 50
1—5x8 Gundlach Star Lens, . . 12 00
1—11x14 Darlot R. H. Lens, list $45, ... 30 00
1—5x8 Darlot R. H. Lens, . . . 15 00
2—4x5 Darlot R. H. Lens, each 10 00
1—10x12 Blair Orthographic, . . 20 00
1—5x8 Wide Angle Lens, . . . 5 00
2—6½x8½ Wide Angle Lens, ea. 8 00
1—11x14 Wide Angle Lens, . . 18 00
1—Pair Waterbury Stereo Lenses, 4 50
2—R. R. Detective Camera Lens, 3 00
1—Set 1-9 Gem Lenses, ... 16 00
1—¼ Gem Lens, ... 1 50
1—4-4 Jamin Globe Lens, . . . 12 00
1—¼ Holmes, Booth & Hayden, 4 00
1—6½x8½ E. A. Single Lens, . 5 00
1—5x8 Single View Lens, . . . 2 00
1—6½x8½ R. O. Co's. View Lens, 2 00

TERMS: NET CASH.

Lenses will be sent with privilege of trial.

THOS. H. McCOLLIN & CO.,

1030 Arch Street, Philadelphia.

$5.00

Pocket Kodaks

$5.00

For Christmas

THE POCKET KODAK does all that a larger camera will do and does it as well—but on a smaller scale. It is perfectly adapted to out-door views, interiors or portraits. Uses either roll film or glass plates and can be loaded in daylight. Takes a roll of film for 12 pictures 1½ x 2 inches and makes such perfect negatives that enlargements can be made to any size. Is about as big as a well filled purse and weighs only 5 ounces. Covered with fine leather. Perfect in workmanship. Rich and dainty in finish. A complete manual explains each step clearly.

Pocket Kodak, loaded for 12 pictures, 1½x2 in., $5.00
Developing and Printing Outfit, " " 1.50

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Sample photo and booklet for two 2-cent stamps.

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Orthoscope Lenses.

RAPID RECTILINEAR.

WIDE ANGLE.

RAPID RECTILINEAR, EMBRACING AN ANGLE OF 75°

	Size of Plate.	Focal Length.	Price.
No. 1, Rapid Rectilinear,	4 x 5	6 inches	$10.00
2, " "	5 x 8	8½ "	15.00
3, " "	8 x 10	11½ "	20.00
4, " "	11 x 14	16 "	30.00

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	Size of Plate.	Focal Length.	Price.
No. 1, Wide Angle,	5 x 8	4¾ inches	$10.00
2, " "	6½ x 8½	6 "	15.00

Perfectly Rectilinear. Quick Acting. Every Lens Guaranteed

PORTRAIT SERIES.

Though but recently introduced, these lenses have given such universal satisfaction that we have no hesitation in recommending them as the best in the market.

They are specially adapted for Portraits, Groups, Landscapes, or Instantaneous Subjects, working sharp to the edge.

The stops for these are cut to the standard sizes of the British Photographic Society.

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4,	1 11/16 "	10¼ "	6½ x 8½	25.00
5,	2⅛ "	12½ "	8 x 10	30.00
6,	2 11/16 "	19½ "	12 x 15	50.00
7,	3 3/4 "	23 "	16 x 20	75.00

WILL BE SENT ON TRIAL ON RECEIPT OF PRICE.

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Put up the display card furnished gratis, they will do the rest. Can also be used for Fancy Cards, Easter Cards, Christmas and New Year Cards, etc.

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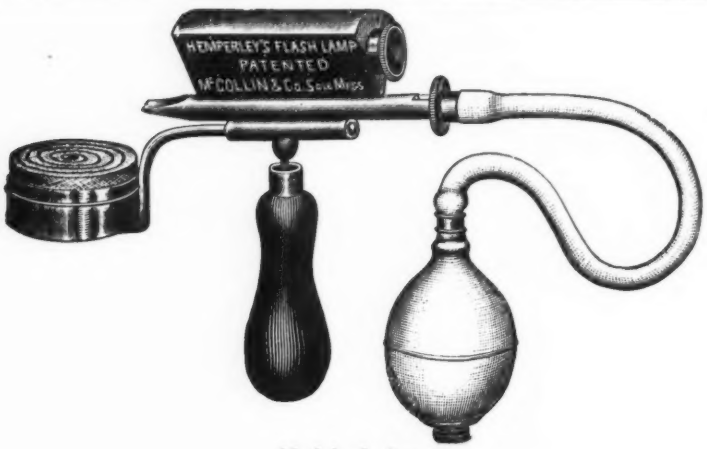

Model of 1893.

HEMPERLEY'S MAGAZINE FLASH LAMP.

SELF LOADING.

For Use With PURE MAGNESIUM POWDER Only.

Manufactured Under the HEMPERLEY PATENT.

In offering our New Magazine Flash Lamp to the Photographic Fraternity both professional and amateur—we do so believing it to be the best article of the kind yet placed on the market.

Each lamp is supplied with a patent rubber bulb, ***with a valve***, which prevents any of the powder being drawn back in the hose or bulb, and in time clogging the air passage.

If you have failed with other Flash Lamps, try our Model of 1893, for a trial will convince even the most skeptical that it is the simplest and really the best form of Lamp yet produced.

Price of Lamp, complete, - - - $2.75
Magnesium, Fine Ground, per oz., .40

All parties are notified that we control the Patents under which this Lamp is manufactured, and propose to protect ourselves against all infringements.

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A Print is not finished until it has passed through an

ENTREKIN
Improved Rotary Burnisher.

FITTED WITH TURN-BACK ROLL AND SWING FIRE-PAN.

THE CHEAPEST AND BEST MACHINES NOW IN THE MARKET.

These Burnishers are especially adapted to burnishing prints made on the

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8 in. Roll, $12.00.	10 in. Roll (light), $15.00.	10 in. Roll (heavy), $25.00.
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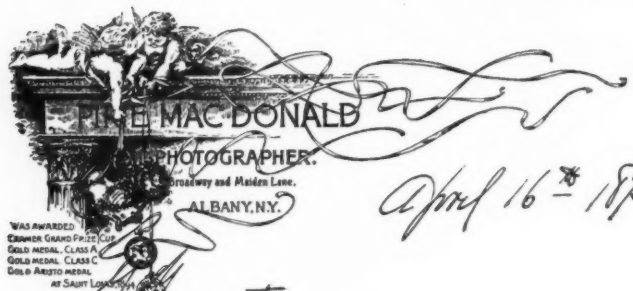

April 16th 1895

J. Jumbert
2426 E. 3rd St. Ny.

Dear Sir

In answer to your favor of the 15th inst would say that I have used Metol for about a year and am much pleased with it.

Yes the negatives that won for me the Cramer Grand prize and the two gold medals were developed into metol, and to Metol I owe no inconsiderable part of my success.

Yours truly

Geo Mac Donald

FOUND IN TIME FOR

The ✱ Detroit ✱ Convention.

New York Dry Plates are Sold by all Photo Stock Dealers.

Cramer Plates.

CRAMER LIGHTNING PLATES.

BANNER—Best Plate for general use.
CROWN—Especially recommended for Hand Cameras and Instantaneous Work.

ASK YOUR DEALER FOR NEW DISCOUNTS ON BANNER PLATES.

CRAMER ISOCHROMATIC PLATES.

SLOW—Full Isochromatic effect without the use of a Color Screen.
MEDIUM—For Landscapes, Interiors, etc.
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We will, in future, ship our Isochromatic Plates direct to the Consumer and charge to any dealer he may designate.

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CRAMER STRIPPING PLATES—For Photo-Mechanical Work.

CRAMER NON-HALATION PLATES—The only Single-Coated Non-Halation Plate on the market.

Full descriptive Catalogue sent to any address upon application.

NEW YORK OFFICE, No. 265 Greene Street.

OFFICE OF

Acme Cycle Company,

ELKHART, IND,

HIGH GRADE BICYCLES.

THE following unsolicited testimonials have been received from newspapers of standing, and we respectfully call attention to them as proof that the ACME is all we claim for it.

THE ACME CYCLE COMPANY.

The Acme Cycle Company is a concern we can heartily recommend as composed of people of sterling worth, their general business running up into the millions each year, the bicycle department being only a portion of it.

The firm lists five splendid looking wheels, and prints some hundred testimonials from riders, all over the country, which tell of their satisfaction with the Acme The Acme Road Racer weighs 22 pounds and lists at $100, full Roadster, 24 pounds, price $90. The Acme Special weighs 25 pounds, and lists at $90, and the Full Roadster weighs 26 pounds and lists at $85. The Acme Belle, a stylish-looking woman's wheel, weighs 27 pounds all on, price $85. Financially the firm is away up.—*American Wheelman.*

THE FRANKFORT BEE.

"TWICE-A-WEEK."

BY BLISS & BLISS. TWENTIETH YEAR.

Best Advertising Medium in Marshall Co.

FRANKFORT, KAN., March 8, 1895.

Mr. Ed. Mitchell, Morris, Ills.

DEAR SIR:—In reply to your request as to my opinion of the Acme Bicycles will say: I have been in the bicycle business for the past four years, and have made the bicycle somewhat of a study I have had for my own use during that period five different wheels, and can honestly say that the Acme wheels are the best constructed, finest finished, and in general the best wheels on the market to-day for the price. I have had some dealings with the Acme people, and can say you will find them nice people to deal with, and their wheels just as represented in every particular. In short, my advice to you is buy an Acme every time.

Respectfully yours,
FRANK D BLISS.

OFFICIAL PAPER OF BAYFIELD COUNTY.
FRED. T. YATES, EDITOR AND MANAGER

THE WASHBURN NEWS.

WASHBURN, WIS., March 8, 1895.

Acme Cycle Co., Elkhart, Ind.

DEAR SIRS:—I am in receipt of your letter of recent date, regarding advertising for this year. The wheel I got of you last year proved more than satisfactory. It received particularly hard usage but stood the test well. I now want one of your 22 pound wheels Have you this in stock. An early answer will oblige,

Yours truly,
FRED. YATES.

THE QUICK PRINT.

WILCOX BROS., Props.,
P. O. Box 505. Spokane, Wash.

March 6, 1895.

Acme Cycle Co., Elkhart, Ind.

GENTLEMEN:—The wheel I bought of you last July has given me the best of service almost constantly since and has been running alongside of $125 Rambler with less repairs and breaks of any and all kinds. However, I desire a new wheel this spring. What have you to offer?

Very truly yours,
W. B. WILCOX,
Spokane, Wash.

THE TRANSCRIPT.

Editorial Office. A. P. HOUGH.

TRAVERSE CITY, MICH., MARCH 8, '95

Acme Cycle Co., Elkhart, Ind.

DEAR SIRS:—The Light Roadster arrived yesterday, and your letter just now. Everything is entirely satisfactory, and the wheel will be paid for to-day. Electro has not arrived yet, but will be inserted in this week's issue if received to-day. If not will have to go over till next week. I appreciate your prompt and courteous treatment, and will endeavor to satisfy you as well as you have me.

Yours truly, A. P. HOUGH.

We Employ Young Men

to distribute our advertisements in part payment for a high grade Acme bicycle, which we send them on approval. No work done until the bicycle arrives and proves satisfactory.

Young Ladies employed on the same terms.

If boys or girls apply they must be well recommended. Write for particulars.

ACME CYCLE COMPANY,
ELKHART, IND.

THOS. H. McCOLLIN & CO.'S

Professional Flash Lamp

PATENTED.

Used with Blitz Pulver.

FOR PORTRAITS, LARGE GROUPS, INTERIORS AND STAGE EFFECTS.

Takes the place of daylight on dull days, takes the place of a skylight on bright days.

As manufacturers of Blitz Pulver, which is used by all manufacturers of Professional Flash Machines, we feel that we are in a position to know what photographers want.

We believe FLASH LIGHT WORK HAS COME TO STAY, and after careful experimentation, we have produced a lamp which combines SIMPLICITY, ECONOMY AND EFFICIENCY. We invite correspondence from photographers, and will publish from time to time samples of the work of the machine in this journal.

This machine requires no gas or gasoline,—burns alcohol,—and is used with Blitz Pulver exclusively. The cut will show its construction.

Thos. H. McCollin & Co.

MANUFACTURERS AND PATENTEES,

1030 ARCH STREET, PHILADELPHIA, PA.

Blitz-Pulver

Blitz-Pulver

Blitz-Pulver

Has a record for flash-light work which is unapproached. No other powder in the United States can show the indorsements of every individual manufacturer of professional flash-lamp which are successfully on the market. Read what they say of it, and then judge. Do not deceive yourself. Flash-light work has come to stay.

ST. JOSEPH, MO., October 6, 1894.

Thos. H. McCollin & Co.

Messrs.:—In regard to your inquiry I will say, I advise the use of "Blitz Pulver" with our machine, and I have used no other powder in getting out our sample negatives. It operates in our machine with unvarying success.

Very respectfully yours,
L. G. BIGELOW.

BRIDGEPORT, CONN., October 27, 1894.

Thos. H. McCollin & Co.

Gentlemen:—We have tried various compounds for flash light powders now on the market, but yours gives the best satisfaction with our machine.

Yours truly,
FAIRCHILD FLASH LIGHT CONCERN.

SAN FRANCISCO, CAL., February 16, 1894.

Gentlemen:—In regard to Blitz Pulver we have always recommended your powder, and our instructions call for it and no other. It is the best powder we have ever used.

[Signed] WILLIAMS & SHEPARD,
Manufacturers Williams Flash Machine.

CORTLAND, N. Y., October 8, 1894.

Thos. H. McCollin & Co., Philadelphia.

Gentlemen:—Will say in regard to "Blitz Pulver" that it is the only flash powder of which we have any knowledge that can be relied upon at all times. We send it out and advise its use with the *Westcott* Flash Machine. When used with this machine it produces beautiful results and with very little smoke.

Respectfully,
WESTCOTT & LEWIS.

MUSCATINE, IA., October 5, 1894.

Thos. H. McCollin & Co., Philadelphia.

Dear Sirs:—We manufacture and sell flash light machines and of all powders we have used find none to compare with Blitz Pulver. We have used it for for all kinds of work, big heads, full forms, opera house stages and interiors, and always find it reliable and quick acting.

Yours respectfully,
CLIFFORD & SON

Price, 60 cents per ounce.

THOS. H. McCOLLIN & CO.,

SOLE MANUFACTURERS,

1030 Arch Street, - - - Philadelphia, Pa.